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THE NEW FABRIC PRETREATMENT & ENHANCEMENT PROCESS

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Abstract

Nonwovens Mechanically bonded with high-pressure water jets is today's fastest growing technology for construction of technical fabrics. Virtually the sky is the limit with products designed to meet today's rigid market requirements at a cost that will be accepted. Hydroentangling (spunlacing) is the answer because of the ability to manufacture nonwoven structures at line speeds up to 300 m/min with carded staple fiber web formations.

The Basics of Hydraulic Enhancement

The InterSpun process uses micro water jets of 0.08-0.15 mm diameter impinging from perforated nozzle strips with 40-120 jets per inch in the form of a curtain onto the cloth with a pressure of 30-250 bar and speeds of up to 300 m/sec. This water is sucked off by means of a suction slot arranged underneath the injector and is returned to the high pressure pumps via an air/water separator and filtration system before being passed through the high pressure jet heads again. During this passage, part of the water (depending on the type of the fiber) between 3 and 5% is continually added as fresh water to compensate for the loss by fabric moisture evaporated in the dryer, water drops in the air/water separator, and backwash water in the filter system. When subjected to the water jets, the material is transported on a suction drum. The fabric can be hydroenhanced on either one or both sides.

By high energy water impinging on the cloth, the yarns blossom and the loose ends of the fibers both within the individual yarns and between adjacent yarns entangle. What may seem like a simple process is in fact quite complex, but through the use of the Fleissner Aqua Tex system, jet heads are designed in such a manner as to distribute the water over the width evenly and at a uniform pressure thus ensuring that each water jet delivers the same energy, resulting in an uniform treatment of the fabric.

There are many factors which must be determined in the machine design to obtain proper enhancement effect and optimum efficiency:

- hole diameter
- hole design
- strip gauge
- strip configuration; i.e. single row, multiple rows
- slot geometry
- angle of the jet
- distance from the outlet to the material
- water pressure
- production speed
- number of jet heads
- one-sided enhancement
- two-sided enhancement
- material tension
- drum design; i.e. weave of the wire, ends & picks, permeability, composition (metal/plastic)
- vacuum level
- dewatering efficiency

If we are familiar with the fabric's properties and aware of the influence between fabric construction and the spunlace process, it becomes quite easy to both control and optimize the process.

These relations between fabric type and process parameters are being developed on a continuous R&D line at Fleissner as well as a pilot line at PGI and both are available to customers that would like to run and evaluate their own material.

What Happens to the Fabric?

Different effects can be observed:

- individual yarns are opened and bloomed
- entangling takes place between the fiber at the crossover points of the warp and fill yarns with the amount of entangling being directly related to the energy applied to the fabric
- the fabric is cleaned very effectively
- the two sides of the cloth can be made balanced or one side can have a more peach-skin like effect
- all process induced material tensions are eliminated
- the warp yarns are repositioned equal distance from each other resulting in improved uniformity

What are Measurable Effects upon the Cloth?

The result of the enhancement technology are extremely remarkable with respect to measurable physical properties of the fabric. Depending on the fabric process parameters, many of the changes listed below occur simultaneously:

- hand and appearance are improved
- material thickness and opacity is significantly increased
- abrasion resistance is improved by up to 300%
- seam slippage is improved up to 200%
- edge tray resistance is improved
- pilling resistance is improved
- wrinkle resistance is optimized
- uniformity of the cloth over the width is improved, faults in fabrics are "ironed out"
- the pore size can be reduced and made more uniform
- dye receptivity of cotton is improved similar to the mercerization process
- the cloth is well cleaned

Ecologically Beneficial Process

It should be noted that the InterSpun process uses only ambient water to achieve it's results. There are no chemicals and the process therefore is ecologically beneficial. The water is run in a closed loop with a certain amount of fresh water added constantly. The process employs a highly efficient filtration system laid out in accordance with the respective fiber type in order to avoid blocking of the jet holes, which might create defective fabric.

Reduction of Raw Material

After hydroenhancement, fabrics usually exhibit physical and application properties normally seen in more heavily constructed cloths that have not been hydroenhanced. In other words, the Fleissner-Aqua Tex system allows production of lighter fabrics (under construct) and thus helps reduce the amount of raw material. BBA Nonwovens did a great deal of development work for the production of so-called "reconstructed cloths". BBA found that in general, fabric constructions can be reduced by 15 – 25 % in filling yarns. This produces savings in raw material s and process labor, etc., which will cover the enhancement costs.

Hydroenhancement of Technical Fabrics

There are four major categories of technical fabrics, where hydroenhancement with the "Aqua Tex" creates significant advantages.

1) Airbag Fabrics. We found that through hydroenhancing we achieved the following advantages compared to regularly finished fabrics:
   a. Achievement of controlled air permeability
   b. The uniformity of the enhanced fabric and the slight bulking and thus decreased slippage of the fiber filaments
   c. The hydroenhanced renders the airbags fabrics super clean
2) E-Glass Fiber Fabrics
   a. The hydroenhanced process allows the filament bundles to open up and spread uniformly

3) Regular Glass Fiber Fabric
    a. Fabrics achieve a much higher filtration efficiency due to the tighter fabric structure created by the decrease in pore size
4) Clean Room Garments
    a. Hydroenhancement causes the fabrics used for clean-room garments to become more uniform and reduces the pore size.