

A Bi-component Nonwoven Fabric of Mostly Cotton Content For Certain Non-Apparel End-USES

Paul Sawhney, Michael Reynolds, Brian Condon, Ryan Slopek, Hiram Allen and David Hui*
Southern Regional Research Center
Agricultural Research Center, U.S. Department of Agriculture
New Orleans, LA 70124

- *University of New Orleans, Mechanical Engineering Department
New Orleans, LA 70148

ABSTRACT

A bi-component, needle-punched nonwoven fabric of predominantly greige (scour-less) cotton (*a sustainable natural fiber*) content has been produced. The fabric may be readily and ideally suitable as a basic stock material for certain custom-designed/decorated household blankets, quilts, bed spreads, cushions, crafts, and the like. This article briefly describes the methodology of producing the stock fabric and its properties.

INTRODUCTION

Depending on its fabricating method or process, a textile fabric is broadly classified as woven, knitted or nonwoven. The woven fabrics comprise by far the largest global market in textiles, followed by the knitted and nonwoven fabrics. The woven and knitted fabrics are made with yarns that are spun from natural or manufactured staple fibers or continuous filament strands. Unlike the traditional woven or knitted fabrics, the nonwoven fabrics are made directly from natural or synthetic fibers without converting the latter into yarns.

The nonwoven fabrics, mainly because of their ultra high production rates and, hence, relatively lower costs are growing rapidly, worldwide. Most of these fabrics today are made with synthetic (generally thermoplastic), regenerated or manufactured fibers, such as polypropylene (PP), polyester (PET), polyethylene (PE), rayon, pulp, and the like. These fibers are clean, uniform, and relatively easy to process and can be converted into strong, integrated nonwoven fabric structures that are viable for many durable, semi-durable, and disposable end-use applications, such as fluid filtration, geo textiles, building and roofing materials, automotives, bedding, hygiene and sanitary products, medical tools and accessories, work uniforms, wipes, oil-spill scavengers, household products, and many more. The PP and PET fibers account for the most consumption in nonwovens today.

Since most synthetic fibers are petroleum-based products, there are growing concerns about their lack of long-term sustainability and their adverse impact on the environment. Synthetic fibers generally are not easily biodegradable as most of the natural fibers are. To preserve the earth's magnificent bounties for the next generations, there is now an escalating global alert to replace or at least partly substitute the environmentally-sensitive and unsustainable materials with natural products that are easily biodegradable, eco-friendly to produce and use, economical, and indefinitely sustainable. Cotton is one such natural fiber that can partly replace the existing synthetic fibers that are most predominantly used in nonwovens today. Cotton fiber offers many attributes that are desirable in nonwovens for many end-use applications, such as wiping products for personal, industrial and institutional uses; medical gauzes and wound dressings; baby and adult diapers and other disposable/flushable sanitary products; work-uniforms; toweling; spill cleansers; household blankets and quilts, and the like. This article briefly describes the production method and properties of a bi-component, nonwoven stock fabric for home sewing-cum-craft projects. The fabric is comprised of ~76% cotton and ~ 24% fusible nylon 6. The results presented here are preliminary and some are even subjective evaluations.

MATERIALS AND METHODS

A quantity of fiber taken from an UltraClean™ (mechanically pre-cleaned) cotton bale^{1,2} was conventionally opened, (further) cleaned, carded,

lapped, and needle-punched, using commercial machinery⁵ and industry-like procedures⁶ and practices. The lightly-needled 100% cotton fabric thus produced was assembled/layered with a low-melting, fusible nylon 6 nonwoven fabric of 30 grams/m² and this bi-component material³ was lightly needled to adequately attach/bond the nylon fabric to the cotton substrate, such that the nylon fiber/fabric is not too deeply embedded into the cotton substrate to cause any integral damage and/or loss of individual integrity of the constituent fibers. A portion of the resulting composite (fabric) was thermally calendared slightly below the nylon's transition point to attain enhanced bonding of the constituents. Depending on the consumer's end-use application, the stock material may be heat-set to achieve permanent dimensional stability of the product.

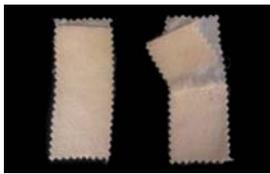


Figure 1 – Fabric specimens for subjective estimation of “delaminating strength” of the bicomponent composite fleece.

RESULTS AND CONCLUSION

The table shows only certain typical properties of the core constituents (base materials/fabrics used) and the developmental, bi-component stock fabric produced. As seen, the novel product has properties that are acceptable for the intended end-use

Table 1 - Properties of a cotton-based nonwoven fabric (A), a low-melting polyamide (nylon) web/fabric (B), and a composite stock fabric (A+B) made thereof.

Constituents/ Composite	Weight (g/m ²)	Thickness (mm)	MD Tensile (N/50mm)	MD elong. (%)	CD Tensile (N/50mm)	CD elong. (%)	Burst Strength (bar)	Drop Test (preliminary check)
Cotton Needle-punched base material (A)	90	1.45	19.3	112.00	22.9	86.13	1.37	Hydro-Phobic, as expected
Polyamide adhesive Web (B)	30	0.28	NA	NA	NA	NA	NA	Hydro-Phobic
Fusible fleece composite (A+B)	120	1.55	22.1	122.60	27.6	88.93	side1/side2 2.37/1.88	Hydro-Phobic, as expected

applications⁴. The delaminating strength test, Figure 1, conducted subjectively indicated that the inter-bonding strength of the two constituent fabrics, namely the cotton base material and the nylon fusible / adhesive fabric, was greater than the tensile strength of the constituent cotton-base material. In conclusion, based on the results of this very preliminary investigation on the feasibility of producing cotton-based, multi-component nonwoven fabric structures using pre-cleaned greige cotton, it seems that there may be several other possible combinations of different fibers/fabrics and production methodologies, which could be utilized for economically producing many end-use-specific nonwoven structures and sandwiched composites⁴ that mostly use cotton and/or its various derivatives and byproducts. Further research focused towards commercial applications is continuing.

References:

1. Wildwood Ginning, Greenwood, MS
2. T.J. Beall & Co., West Point, GA.
3. Pellon^R PCP Group LLC, N. St. Petersburg, FL
4. Communications with retailers of textiles and crafts
5. Communications with Technoplants srl, Pistoia, Italy, (www.techno-plants.com).
6. Communications with Foster Needle Co., Spartanburg, SC.

Notes:

1. *The SRRC is a federal research facility of the US Department of Agriculture.*
2. *The names of the companies and/or their products are mentioned solely for the purpose of identifications and do not in any way imply their endorsement by the USDA.*