



A Brief Introduction to Non-Woven Fabrics

Introduction

Non-woven fabric is a fabric-like material made from long fibers, bonded together by chemical, mechanical, heat or solvent treatment. The term is used in the textile manufacturing industry to denote fabrics, such as felt, which are neither woven nor knitted. Non-woven materials typically lack strength unless densified or reinforced by a backing. In recent years, nonwovens have become an alternative to polyurethane foam.

Applications

Non-woven fabrics are broadly defined as sheet or web structures bonded together by entangling fiber or filaments (and by perforating films) mechanically, thermally or chemically. They are flat, porous sheets that are made directly from separate fibers or from molten plastic or plastic film. They are not made by weaving or knitting and do not require converting the fibers to yarn. In many cases, a certain percentage of recycled fabrics and oil-based materials are used in non-woven fabrics. The percentage of recycled fabrics vary based upon the quality of material needed and the specific use.

Non-woven fabrics are engineered fabrics that may be a limited life, single-use fabric or a very durable fabric. Non-woven fabrics provide specific functions such as absorbency, liquid repellency, resilience, stretch, softness, strength, flame retardancy, washability, cushioning, filtering, bacterial barrier and sterility.

These properties are often combined to create fabrics suited for specific applications, while achieving a good balance between product use-life and cost. They can mimic the appearance, texture and strength of a woven fabric and can be as bulky as the thickest paddings. In combination with other materials they provide a spectrum of products with diverse properties, and are used alone or as components of apparel, home furnishings, health care, engineering, industrial and consumer goods.

Non-woven materials are used in numerous applications currently, including:

Hygiene

- baby diapers
- feminine hygiene
- adult incontinence products
- wet wipes
- bandages and wound dressings

Medical

- isolation gowns
- surgical gowns
- surgical drapes and covers
- surgical scrub suits
- caps

Filters

- gasoline, oil and air - including HEPA filtration
- water, coffee, tea bags
- liquid cartridge and bag filters
- vacuum bags
- allergen membranes or laminates with non woven layers

Geotextiles

- soil stabilizers and roadway underlayment
- foundation stabilizers
- erosion control
- canals construction
- drainage systems
- geomembranes protection
- frost protection
- agriculture mulch
- pond and canal water barriers
- sand infiltration barrier for drainage tile

Manufacturing processes

Non-wovens are typically manufactured by putting small fibers together in the form of a sheet or web (similar to paper on a paper machine), and then binding them either mechanically (as in the case of felt, by interlocking them with serrated needles such that the inter-fiber friction results in a stronger fabric), with an adhesive, or thermally (by applying binder (in the form of powder, paste, or polymer melt) and melting the binder onto the web by increasing temperature).

Staple non-wovens

Staple non-wovens are made in 2 steps. Fibers are first spun, cut to a few centimeters length, and put into bales. These bales are then dispersed on a conveyor belt, and the fibers are spread in a uniform web by a wetlaid process, airlaying or carding. Wetlaid operations typically use short fibers, 1/4" to 3/4", but sometimes longer if the fiber is stiff or thick. Carding operations typically use ~1.5" long fibers. Rayon used to be a common fiber in nonwovens, now greatly replaced by PET and PP. Fiberglass is wetlaid into mats for use in roofing and shingles. Synthetic fiber blends are wetlaid along with cellulose for single-use

fabrics. Fibers can also be arranged in a web via airflow or mechanical means, often carding. Staple non-wovens are bonded by using either resin or thermally. Bonding can be throughout the web by resin saturation or overall thermal bonding or in a distinct pattern via resin printing or thermal spot bonding. Co-forming usually refers to a combination of two dissimilar fibers that are formed and bonded together and offer the advantages of both fibers.

Meltblown non-wovens

Meltblown non-wovens are produced by extruding melted polymer fibers through a spin orifice or die consisting of up to 40 holes per linear inch to form long thin fibers which are stretched and cooled by passing hot air over the fibers as they fall from the die. The resultant web is collected into rolls and subsequently converted to finished products. The extremely fine fibers typically polypropylene differ from other extrusions particularly spun bond in that they have low intrinsic strength but much smaller size offering key properties. Often melt blown is added to spun bond to form spun-melt (SM) or spun-melt-spun (SMS) webs, which are strong and offer the intrinsic benefits of fine fibers such as fine filtration, low pressure drop as used in face masks or filters and physical benefits such as acoustic insulation as used in dishwashers. One of the largest users of SM and SMS materials is the disposable diaper and feminine care industry.

Spunlaid non-wovens

Spunlaid non-wovens are made in one continuous process. Fibers are spun and while molten, are stretched to introduce polymer orientation and strength and then directly dispersed into a web by deflectors or can be directed with air streams. This technique leads to faster belt speeds, and low cost yet strong fabrics. Several variants of this concept are available. PP spunbonds run faster and at lower temperatures than PET spunbonds, mostly due to the difference in melting points. Spunbond has been combined with meltblown non-wovens, conforming them into a layered product called SMS (see above). Meltblown non-wovens have extremely fine fiber diameters but are not strong fabrics. SMS fabrics,

made completely from PP are water-repellent and fine enough to serve as disposable fabrics. Meltblown is often used as filter media, being able to capture very fine particles. Spunlaid is bonded by either resin or thermally.

Air-laid paper

Air-laid paper is a textile-like material categorized as a nonwoven fabric generally made from wood pulp plus natural or synthetic fibers in a blend. Unlike the normal papermaking process, air-laid paper does not use water as the carrying medium for the fiber. Fibers are carried and formed to the structure of high-bulk and absorbent paper by air.

Other types

Non-wovens can also start with films and fibrillate, serrate or vacuum-form them with patterned holes. Fiberglass nonwovens are of two basic types. Wet laid mat or “glass tissue” use wet-chopped, heavy denier fibers in the 6 to 20 micrometer diameter range. Flame attenuated mats or “batts” use discontinuous fine denier fibers in the 0.1 to 6 range. The latter is similar, though run at much higher temperatures, to meltblown thermoplastic nonwovens. Wet laid mat is almost always wet resin bonded with a curtain coater, while batts are usually spray bonded with wet or dry resin. An unusual process produces polyethylene fibrils in a Freon-like fluid, forming them into a paper-like product and then calendering them to create Tyvek™.

Bonding

Both staple and spunlaid non-wovens would have no mechanical resistance in and of themselves, without the bonding step. Several methods can be used:

- thermal bonding
 - using a large oven for thermal activation and fusing of the fibers,
 - calendering through heated rollers (called spunbond when combined with spunlaid), calenders can be smooth faced for an overall bond or patterned for a softer, more tear resistant bond.
- hydro-entanglement: mechanical intertwining of fibers by water jets (called spunlace).
- ultrasonic pattern bonding, often used in high-loft or fabric insulation/quilts/bedding.
- needlefelt: mechanical intertwining of fibers by needles.
- chemical bonding (wetlaid process): use of binders (such as latex emulsion or solution polymers) to chemically join the fibers. A more expensive route uses binder fibers or powders that soften and melt to hold other non-melting fibers together.
- one type of cotton staple nonwoven is treated with sodium hydroxide to shrink bond the mat, the caustic causes the cellulose-based fibers to curl and shrink around one another as the bonding technique.
- meltblown is very weakly bonded from the air attenuated fibers intertwining with themselves during web formation as well as the temporary tackiness when they are forming.
- one unusual polyamide spunbond (Cerex) is self-bonded with gas-phase acid.

A good public source of detailed information on non-wovens is available at

<http://web.utk.edu/~mse/Textiles/index.html>

Contact Us

Biovation's expertise is in infection control formulations and we look forward to partnering up with you. We invite you to contact us solutions@biovation.com to discuss how Biovation can help you with our portfolio of technologies and solutions.

© Copyright All Rights Reserved 2010

Biovation LLC

55 Industrial Park Road
Boothbay, ME 04537 USA
Ph: 207-633-0616
Fax: 207-633-0614
www.biovation.com