

# 23. Overview of Non-wovens Manufacturing

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## Learning objectives

On completion of this topic you should be able to:

- Explain the benefits and limitations of the nonwoven route for textile manufacture
- List the main fibres used in nonwovens and their features that make them suitable for this application
- Outline
  - the various approaches to the formation of a fibrous web
  - the various methods used for the consolidation and bonding of fibrous webs
  - chemical and mechanical finishing treatments and their purposes

## Key terms and concepts

Nonwovens, felt, needlefelts, fibres, web, drylaid, carding, airlaid, wetlaid, spunlaid, meltblown, chemical bonding, mechanical bonding, needlepunching, hydroentanglement, thermal bonding, finishing treatments

## Introduction to the topic

While woven, knitted and tufted goods make up the largest quantity of textile fabrics produced, other fabric forming methods are available that do not require the prior making of a yarn, or weaving or knitting steps. These products, which are called *nonwovens*, are produced by the direct conversion of fibre to fabric. Nonwovens have a wide range of applications, which include home textiles, personal hygiene products and technical textiles. As well as the unique products that can be made by the nonwovens method, a major advantage is the relatively low cost of manufacture.

Nonwovens may be formed by numerous techniques and may be classified as follows:

(a) Felts (formed from wool and other animal fibres):

- true felts
- needle felts

(b) Nonwoven or bonded fabrics (formed mostly from synthetic fibres)

- chemically bonded nonwovens (wet-bonded, thermoplastically bonded, spun bonded)
- mechanically bonded (needled, needled and shrunk, stitched)

This lecture will focus on nonwovens fibres and processing systems that are widely used and the subsequent lecture (Mechanical felting processes and products) will concentrate on the production of nonwoven fabrics by the carding and needlepunching route. This route offers the best opportunities for wool in nonwovens, currently a small but promising product area.

A number of web sites, which are listed under Useful Web Sites, have extensive information on all aspects of nonwovens manufacture. Of these, the most comprehensive site is [Apparel Search Company](#), which is the principle reference for this lecture.

## 23.1 What are nonwovens?

A nonwoven is a manufactured sheet, web or batt of directionally or randomly oriented fibres which are bonded by friction and/or cohesion and/or adhesion. Specifically excluded from this category of textiles are papers or woven, knitted or tufted fabrics.

Conventional textile fabrics use yarns to form a fabric, with interlacing of the yarns through weaving or knitting to provide strength. On the other hand, in nonwovens single fibres are assembled to form a web, to which some means of fibre bonding is applied to provide the required web strength.

Felts, a traditional type of nonwoven are formed from wool and other animal fibres. These fabrics can be divided into:

- a) true felts, which are formed by agitation of a random wool web in the presence of water, and
- b) needle felts, where the fibres are intermingled by mechanical action, ie, needle-punching.

The other main types of nonwoven products, more common in today's markets, are the bonded fabrics, which are mostly made of synthetic fibres. These comprise two types:

- 1) Chemically-bonded nonwovens
- 2) Mechanically bonded nonwovens.

By avoiding the use of yarn, nonwovens are cheaper to manufacture (Ford, 1995). Consider the typical cost components for a woven polyester/cotton fabric having a cost of 100 units (Table 23.1). If a fabric of the same weight was made by the nonwoven process the same 23 units for the fibre cost would still be needed, but the 18 units for spinning would not. The 33 units for weaving (including beaming, sizing and winding) would be replaced by fabric forming costs of about 15. The finishing cost would be eliminated. Therefore, a nonwoven would typically cost 38 units instead of 100.

**Table 23.1 Cost components for woven and nonwoven fabrics. Source: Wood, 2006.**

Manufacturing costs	Woven fabric	Nonwoven fabric
Raw fibres	23%	23%
Yarn spinning	18%	-
Fabric formation	33%	15%
Finishing	26%	-
	100%	38%

## 23.2 Fibres for nonwovens

Fibres are the basic elements on nonwovens, and a wide range of fibres is used, depending on the type of end product. These include traditional textile fibres as well as modern high-tech fibres. The fibres can be in the form of filament, staple fibre or even yarn. Today's requirements are for fibres for

- Lightweight materials typically used in disposable nonwoven products, and
- Durable, chemically-resistant and strong materials for durable nonwoven applications.

Table 23.2 shows the significant fibres used in the nonwovens industry all over the world.

**Table 23.2 Fibres used in the nonwoven industry. Source: Wood, 2006.**

Natural fibres	Manmade fibres	Hi-tech fibres
Cotton	Polypropylene	Aramid (Nomex, Kevlar)
Wool	Nylon	Bicomponent
Wood	Rayon	Superabsorbant
	Lyocell	Hollow fibres
	Modacrylic	Spandex
	Polyethylene terephthalate	Glass microfibre
		Antibacterial fibre
		Stainless steel

Of the natural fibres available, wood pulp is the only one that is used in large amounts because of its high water absorbency, bulk and low cost. Another cellulosic fibre, cotton also has excellent properties for nonwovens. Viscose rayon has been widely used in the areas of disposables and sanitary products.

Among the synthetic fibres polypropylene is the most widely used, because it is inexpensive and has the appropriate characteristics to form fine fibres. In addition, they are hydrophobic, low density, resistant to a wide range of chemicals and thermoplastic. Polyethylene terephthalate is used where strength and flexibility are of prime importance. Nylon fibres are used for their excellent recovery (resilience properties), but are relatively expensive. Bi-component fibres, with different polymers in the core and the sheath, are widely used in thermally-bonded nonwovens.

Currently, world-wide consumption of textile nonwovens is around 3 million tonnes, with man-made fibres dominating at 99%. The major fibres are polypropylene (62%), polyester (24%) and viscose rayon 8% (Anon, 1997).

See the Reading – *Fibres for Nonwovens* for more extensive information on the fibres used in this sector.

## 23.3 Nonwovens manufacturing

Nonwoven processes consist of three stages:

- Web formation
- Web bonding
- Finishing treatments

### Web formation

Web formation transforms fibres, filaments, films or thermoplastic resins into preferentially arranged layers of lofty and loosely held fibre networks called webs, batts, mats or sheets. Mechanical and fluid methods are used to achieve the required fibre or film orientation in the web through the use of machinery that has been adapted from the textile, paper and extrusion industries. In all nonwoven manufacturing systems the fibre material is deposited or laid on a forming and conveying surface. The physical environment at this stage may be dry, wet, quenched or molten, hence the terms *drylaid*, *wetlaid* and fluid polymer laid (or *spunlaid*).

The processes for forming the webs for nonwoven fabrics can be grouped into four general categories:

- Textile-related
- Paper-related
- Extrusion polymer processing related
- Hybrid combinations

Table 23.3 shows the fibre technologies and web formation methods used in the manufacture of nonwovens. Wool qualifies as a long staple fibre and is handled by drylaying.

**Table 23.3 Fibre technologies and web formation methods. Source: Wood, 2006.**

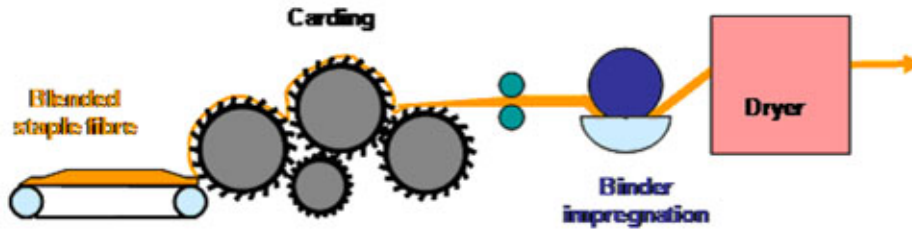
	Spunlaying	Meltblowing	Wetlaying	Airlaying	Drylaying
Polymer	X	X			
Long staple fibre					X
Short staple fibre			X	X	
Pulp			X	X	

### Textile-related web formation

Textile technologies include garmetting, carding, and aerodynamic forming of fibers into selectively oriented webs. Fabrics produced by these systems are referred to as drylaid nonwovens, and they are produced by two methods, carding and airlaying.

Figure 23.1 shows a *drylaid* processing line involving carding with subsequent impregnation with a bonding agent.

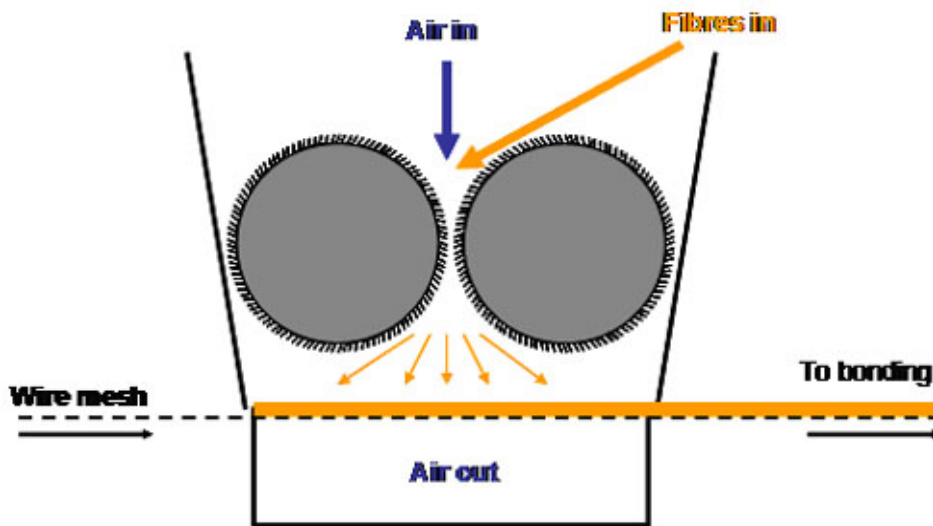
Figure 23.1 Web formation by drylaying (carding). Source: Wood, 2006.



Carding is a mechanical process which starts with the opening of bales of fibres, which are blended and conveyed to the card by air transport. The carding machine converts the fibres into a web, through the action of rotating drums covered with fine teeth. The fibres may be parallel laid or random laid, depending on the product requirements. This is the most versatile system for high-loft web formation.

Figure 23.2 shows an *airlaid* processing line for short fibre.

Figure 23.2 Web formation by airlaying. Source: Wood, 2006.



In *airlaying*, the fibres, which can be very short, are fed into an airstream and from there are transferred to a moving belt or drum where they form a randomly oriented web. Compared to carded webs, airlaid webs tend to have a lower density, are softer and the absence of a layered structure. Such webs offer great versatility in terms of the fibres (and fibre blends) that can be used. This is the most streamlined system.

Textile-based nonwoven fabrics, or fiber-network structures, are manufactured with machinery designed to manipulate textile fibers in the dry state. Also included in this category are structures formed with filament bundles or tow, and fabrics composed of staple fibers and stitching threads. In general, textile-technology based processes provide maximum product versatility; since most textile fibers and bonding systems can be utilized and conventional textile-fiber processing equipment readily can be adapted with relatively low capital outlay.

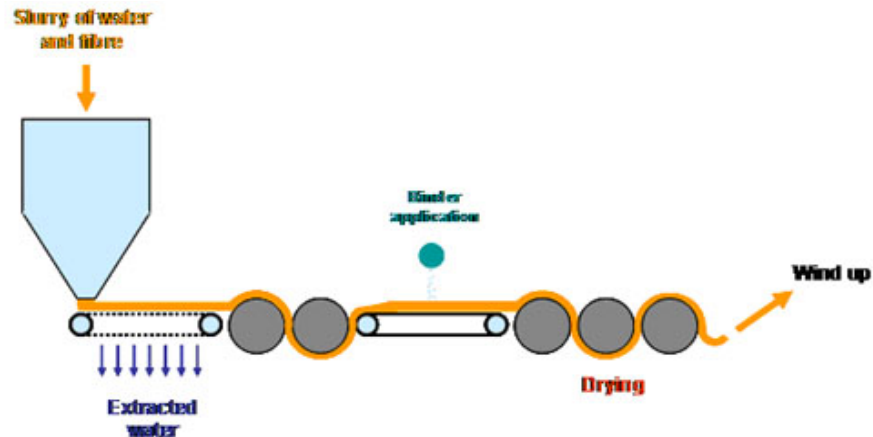
### Paper-related processing

Paper-based technologies include drylaid pulp and wetlaid (modified paper) systems designed to accommodate short synthetic fibers, as well as wood pulp fibers. Fabrics produced by these systems are referred to as drylaid pulp and wetlaid nonwovens. A major objective of wetlaid nonwoven manufacturing is to produce fibrous structures with textile fabric characteristics (especially flexibility and strength), at speeds approaching those used for paper making. Paper-based nonwoven fabrics are manufactured with machinery designed to manipulate short fibers suspended in fluid.

In wetlaid nonwovens manufacture a dilute slurry of water and fibres is deposited on a moving wire screen and drained to form a web. The web is further dried, consolidated by pressing between rollers and dried. Impregnation with binders is often included in a later stage of the process.

The wetlaid process is shown in Figure 23.3.

**Figure 23.3 Web formation by wetlaying. Source: Wood, 2006.**



Wetlaid web forming allows a wide range of fibre orientations, ranging from near random to near parallel. A wide range of natural, mineral and man-made fibres of varying lengths can be used.

Paper-technology based nonwoven processes provide the least product versatility and require extensive capital outlay, but they yield outstanding uniformity in products at exceptional speeds.

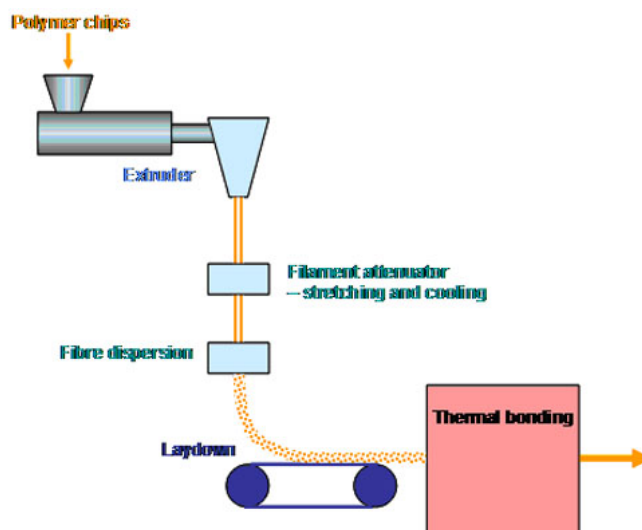
### Polymer extrusion-related processing

Extrusions include spunbond (or spunlaid), meltblown, and porous film systems. Fabrics produced by these systems are referred to individually as polymer-laid nonwovens. Extrusion-based nonwovens are manufactured with machinery associated with polymer extrusion, as used in the production of synthetic filaments. In polymer-laid systems, fibre formation, web formation and web consolidation are performed as an integrated operation.

In the formation of **spunlaid fabrics**, polymer granules are melted and the molten polymer is extruded through spinnerets. The continuous filaments thus formed are cooled and deposited on to a conveyor belt to form a uniform web. The filaments may be sufficiently warm so that the filaments can adhere to each other, but this is not the principle method for bonding the web.

The principle of the spunlaying process is shown in Figure 23.4.

**Figure 23.4 Web formation and consolidation by spunlaying. Source: Wood, 2006.**



**Melt blown** nonwovens manufacture is an integrated fibre-to-fabric process that does not involve individual spinneret holes. A stream of molten polymer is extruded from a diehead and this is blown forward by a blast of hot air (250-500°C). This splits up the molten stream into a network of fine fibres which accumulates on a rotating screen to form a fibrous web which is compressed between heated rollers.

**Flash spun** webs are made by dissolving a polymer in a suitable solvent and then spraying it into a vessel held at reduced pressure. The solvent evaporates (or flashes off), leaving a cloud of fibres which are collected and bonded.

Extrusion-technology based processes provide somewhat less versatility in product properties, but they yield fabric structures with exceptional strength-to-weight ratios (spunbonds), high surface-area-to-weight characteristics (meltblown), or high property uniformities per unit weight (textured films) at substantial to modest capitalization levels.

Coverstock, the lightweight material used to cover absorbent cores in medical or personal hygiene products, is the main product made by the spunlaid and melt blown processes.

### Hybrid processing systems

Hybrids include fabric/sheet combining systems, combination systems, and composite systems. Combining systems employs lamination technology or at least one basic nonwoven web formation or consolidation technology to join two or more fabric substrates. Combination systems utilize at least one basic nonwoven web formation element to enhance at least one fabric substrate. Composite systems integrate two or more basic nonwoven web formation technologies to produce web structures. Hybrid processes combine technology advantages for specific applications.

## 23.4 Bonding methods

Strength and coherence can be added to a fibrous web by three bonding methods:

- Chemical bonding
- Mechanical
- Thermal bonding

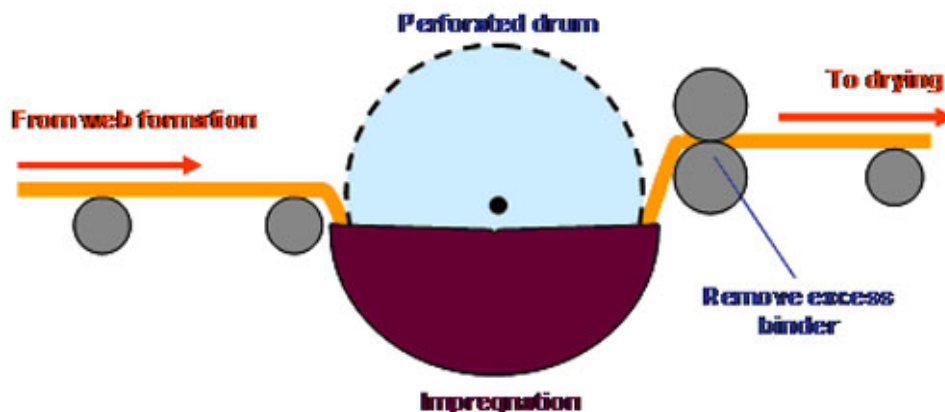
The degree of bonding is a primary factor in determining fabric integrity (strength), porosity, flexibility, softness and density (loft, thickness). Bonding may be carried out as a separate operation, but is generally carried out in tandem with web formation.

### Chemical bonding

Chemical bonding is the application of a liquid-based bonding agent to the fabric, in a number of ways: impregnating, foam, spraying or print bonding. The chemical binder most frequently used is a water-borne latex which is an economical, versatile, easily applied and effective adhesive. Most latex binders are made of vinyl materials such as polyvinylacetate, polyvinylchloride, styrene/butadiene resin and polyacrylic or their combinations.

**Impregnation (or saturation) bonding** is used where rapid application of the binder is required and for fabric applications require strength, stiffness and maximum fibre encapsulation. This is achieved by totaling immersing the web in a binder bath (Figure 23.5) or by flooding the web as it enters the nip point of a set of pressure rollers.

Figure 23.5 Web consolidation by impregnation by a binder. Source: Wood, 2006.



**Spray bonding** is used for fabric applications where it is desired to maintain a high loft or bulk. The binder is atomized and applied to the upper surfaces of the web by a series of nozzles. After spraying, the web is passed through heating zones to first remove water and then to cure the binder.

**Print bonding** applies binder in predetermined areas only and is used for fabric applications that require some areas of the fabric to be binder-free. Printing patterns are designed to enhance strength, fluid transport, softness, absorbency and drape.

**Foam bonding** is a means of applying a binder at low water and high binder-solids concentration levels. Air as well as water is used as the binder dilutant and the carrier medium. The foam is generated by introducing air into the latex while mechanically agitating the binder solution. With the addition of a stabilising agent to the binder solution, the bonded fabric will have enhanced loft and resilience.

## Mechanical Bonding

In mechanical bonding the strengthening of the web is achieved by interfibre friction as a result of the physical entanglement of the fibres. There are two types of mechanical bonding:

- Needlepunching
- Hydroentanglement

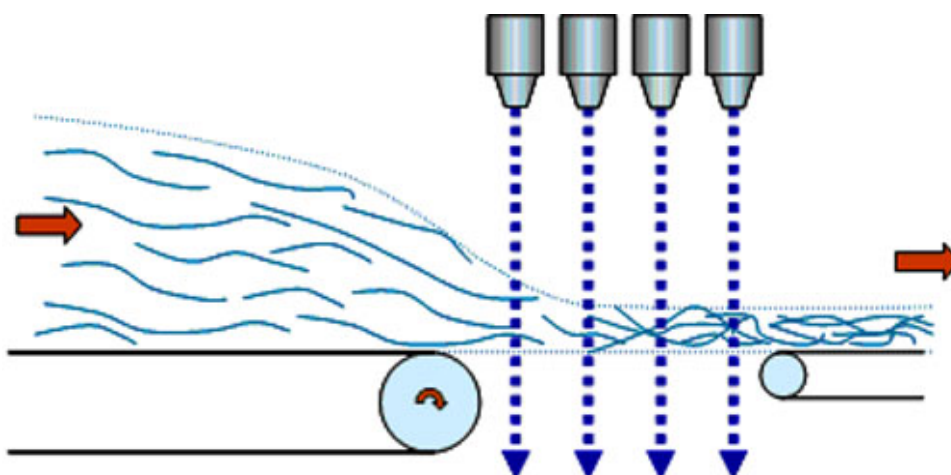
**Needlepunching** can be used on most fibre types. Specially designed, barbed needles mounted on reciprocating beds, are pushed and pulled through a thickly-laid web to entangle the fibres. The needle penetration causes a stitching action where loops are transferred from one surface of the web to the other, thus developing fabric coherence. Webs of different characteristics can be needled together to produce a range of properties difficult to achieve by other means. The main application is in needlepunched floorcoverings, which differ from conventional carpet by having a randomized, flat fabric surface. Special needle techniques may be used to pluck a more vertical pile or produce a rib effect.

This method of web stabilisation is covered in detail in the lecture *Mechanical felting processes and products*.

**Hydroentanglement** (Figure 23.6) is mainly applied to carded or wetlaid webs for either web consolidation, fabric surface texturing purposes or both. When used for web consolidation, the technique uses fine, high-pressure jets of water to cause the fibres to interlace, hence the technique is often called *spunlacing*. The arrangement of jets, which operate rather like needling by transferring fibre loops through the thickness of the web, can give a wide variety of aesthetically pleasing effects, while the water jet pressure has a direct influence on the strength added to the web. This process operates at a high speed of up to 100 metres per minute.

Nonwoven fabrics that have undergone a hydroentanglement treatment contain no chemical binders and have not been thermally bonded. They are used in a range of products and are mostly made from polyester. This method produces a fabric with a soft, flexible handle.

Figure 23.6 Web consolidation by hydroentanglement. Source: Wood, 2006.



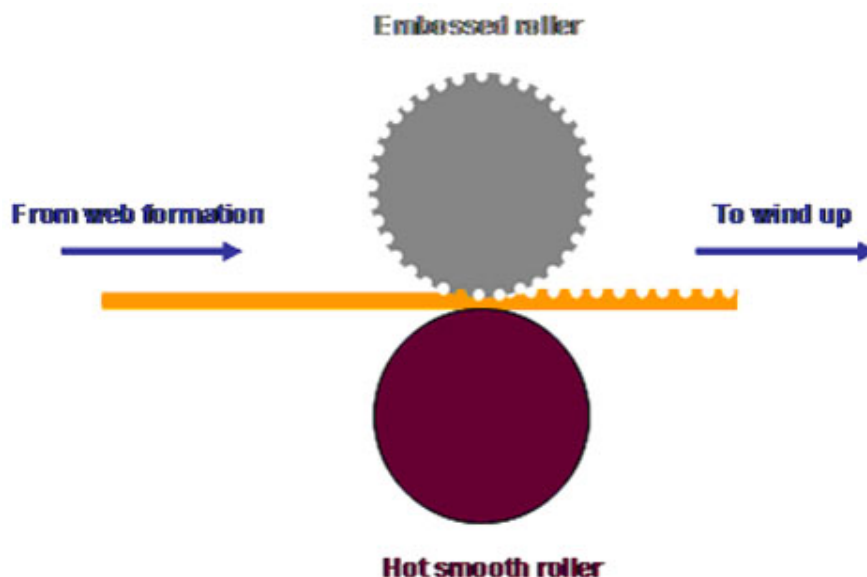
While hydroentanglement is mostly used with synthetic fibres, significant progress has recently been made in applying the technology to wool.

### Thermal bonding

Thermal bonding methods interlock fibres through the use of heat energy to activate an adhesive system

This process is widely used for low-melting, thermoplastic fibres, especially polypropylene and polyethylene. Thermal bonding is achieved by passing the fibre web between heated metal cylinders, which fuse and bond fibres mainly at their crossing points where the pressure is greatest (Figure 23.7). Alternatively, binder fibres or powders may act as the adhesive.

Figure 23.7 Web consolidation and embossing by thermal bonding. Source: Wood, 2006.



A grooved roller enables embossing of the fabric to be undertaken. Alternative to heated rollers, ultrasonic bonding or radiation heating systems may be used to give the temperatures required to activate the bonding process.



## 23.5 Nonwoven fabric finishing

The production of nonwoven fabrics is carried out as either a continuous process, with fibre or resin as the input material and a roll of fabric as the output, or as a series of batch processes. Correspondingly, fabric finishing is carried out either in tandem with web formation and consolidation or off-line as a separate operation.

Slitting and winding are common finishing processes for all nonwoven fabrics that are produced in roll form. Roll width is determined at the slitting operation and roll length is determined at the winding operation. The dimensions of nonwoven roll goods are varied to accommodate the fabric end use or subsequent processes.

Nonwovens may be given a range of finishing treatments in order to enhance fabric performance of aesthetic properties. Performance properties include functional characteristics such as moisture content and transport, absorbency, repellancy, flame retardancy, electric response, abrasion resistance and friction behaviour. Aesthetic properties include various attributes such as appearance, surface texture, colour and odour.

Nonwoven finishing processes can be categorized as being chemical, mechanical or thermal-mechanical.

### Chemical finishing

This involves the application of chemical agents as coatings to fabric surfaces or the impregnation of fabrics with chemical additives or fillers. In many cases chemical finishing is an extension of the binder application process.

Generally, the coating process is applied to enhance the properties of the nonwoven structure. The coating may be applied as a continuous covering or as a pattern. The coating material is frequently applied as a solvent, aqueous solution or molten polymer. When working with many nonwoven substrates, special care must be taken due to the delicate nature of the structure itself or the arrangement of fibres on or near the fabric surface.

### Mechanical and Thermal Finishing

Mechanical finishing involves altering the texture of fabric surfaces by physically reorienting or shaping fibres on or near the fabric surface. Thermal finishing, such as calendaring, enables structural changes to be permanently set into the fabric by the application of heat.

Surface structures may be established by embossing, compressive shrinkage (creping) and by creating loops or pile. Surface textures, ranging from flat and smooth to raised and leveled, may be altered by calendaring, sueding, napping, polishing, brushing and shearing.

In general, mechanical finishing processes operate at speeds lower than web consolidation processes, and consequently are carried out offline or as separate batch processes.

- Smooth surfaces are normally produced by **calendaring**, a process which subjects the fabric to pressure between two rollers for a controlled time and temperature.
- In **sueding** the fibres on the surface of a lubricated fabric are cut by the abrasive action of a high speed sanding roller.
- The **napping** process raises fibres to the surface of a lubricated fabric by withdrawing the fibres from the interior of the fabric. The napping action takes place as the wires of the working rollers penetrate the fabric, withdraw fibres and form a nap of raised fibres on the surface of the fabric. A wide range of loop or velour surface effects can be produced.
- In **polishing** the pile of a raised fabric surface is selectively oriented. The mechanical action of the rotating edge of a spirally-grooved, heated cylinder against the tensioned fabric surface results in a static electrification of the pile fibres, which orients the fibres in a parallel fashion. Rotation of the spiral roller in the direction that momentarily entraps fibres in the grooves results in a raised parallel pile surface. Rotation of the spiral roll in the opposite direction produces a flat, parallel pile surface.

- **Brushing** lifts the fibres to the fabric surface and orients the raised fibres along the machine direction of the fabric.
- **Shearing** cuts raised fibres to uniform heights using a series of spirally wound shearing blades rotating over a stationary blade. Shearing usually follows a brushing operation

## Readings

The following readings are available on CD:

1. Wood, E.J. Fibres for non-wovens. Canesis Network Ltd., Christchurch, New Zealand.

## Activities



Available on WebCT

## Multi-Choice Questions



Submit answers via WebCT

## Useful Web Links



Available on WebCT

## Assignment Questions



Choose ONE question from ONE of the topics as your assignment. Short answer questions appear on WebCT. Submit your answer via WebCT

## Summary

While woven, knitted and tufted goods make up the largest quantity of textile fabrics produced, other fabric forming methods are available that do not require the prior making of a yarn, or weaving or knitting steps. These products, which are called *nonwovens*, are produced by the direct conversion of fibre to fabric. Nonwovens have a wide range of applications, which include home textiles, personal hygiene products and technical textiles. As well as the unique products that can be made by the nonwovens method, a major advantage is the relatively low cost of manufacture.

Nonwoven fabrics may be formed by numerous techniques, but all generally involve web formation, bonding and finishing steps. This lecture focuses on nonwovens fibres and processing systems that are widely used, not necessarily using wool. Polyester is currently the leading fibre used in nonwovens.

Web formation can be carried out using dry laying, air laying, wet laying or spun laying techniques. The bonding of a web may be achieved by chemical, mechanical or thermal means. Nonwoven fabric finishing also involves a choice of chemical, mechanical or thermal techniques. The subsequent lecture (*Mechanical felting processes and products*) will concentrate on the production of nonwoven fabrics by the carding and needlepunching route, ie, drylaying.

## References

Anon, 1997, World Markets for Nonwovens and Other Non-spun Products – Forecasts to 2005, Textiles Intelligence Ltd, London.

Apparel Search Company. An apparel industry directory providing members of the fashion industry with links to virtually every aspect of apparel, fashion, textiles and clothing. Available at <http://www.apparelsearch.com/>.

Ford, J., 1995, Nonwovens, Textiles Magazine, 18-20.

## Glossary of terms

Absorption	The process by which a material takes in a gas or liquid
Adsorption	The adhesion on the surface layer of a material by a gas or liquid
Airforming, airlaying	The technique of dispersing fibres in a moving airstream and then collecting on a forming surface to produce lofty, porous webs
Arachne machine	A Czechoslovakian machine that uses knitting elements for stitchbonding nonwovens
Backing	A reinforcing material for the back layer of products such as carpet or wallpaper
Backsheet	The backing material on an absorbent product such as a diaper or adult incontinence product, usually constructed of polyethylene or polyethylene with a nonwoven laminated to it
Bacteriostat	Chemical additive that inhibits the growth of bacteria
Basis weight	Weight of a unit area of fabric, sheet, or web
Batt	Lofty and loosely held fibre network (also see Web)
Beater	Machine that separates and cleans fibres prior to web formation
Bicomponent fibre	Fibre combining segments of two differing compositions, generally side-by-side or one inside another (core and sheath)
Binder	A material added during or after web formation that causes fibres to adhere to one another in webs; also used to describe material to adhere pigments, etc., to a surface
Binder fibre	A fibre with a lower melting point than other matrix fibre or web elements that is activated through the application of heat (also see Thermal Bonding)
Blend	Two or more fibre types combined
Bonding	The process of joining fibres in a web to provide strength
Brushing	A mechanical finishing process of lifting fibres to the fabric surface and orienting the raised fibre in the machine direction of the fabric
Bulking	The process of adding volume to fabrics; can entail increasing crimp of constituent fibres
Burst strength	The force required to rupture a fabric
Calender	A machine consisting of two or more cylinders or rolls that can apply controlled and uniform pressure to a fabric or web as it goes through the nip
Calendaring	A finishing process that subjects fabric to pressure and sometimes heat in order to bond, emboss, or compact
Card	A machine that combs or works fibres between the fine surfaces or points of a toothed surface in order to separate, clean, and align the fibres in a parallel orientation
Carding	The process that transforms entangled fibre mats into parallel fibrous webs
Carrier web	A transporting member for moving a material through a processing stage
Cellulose	A polymeric substance that constitutes the chief part of the cell wall of plants and is naturally in fibrous products such as cotton, flax, rayon, and jute
Chemical finishing	The process of adding chemicals to a web or fabric in order to enhance properties such as flame resistance, wetting, repellency, colour, etc.

Clothing (card)	The combing or working points on a card cylinder
Coating	A finishing material applied to the surface of fabric, generally in a very uniform manner
Composite	A layered structure that combines a nonwoven material with other layered materials, wherein there is an integrated interface
Converting	Final steps in manufacturing nonwoven products from roll goods. The process of changing a nonwoven fabric in a final, finished product, generally involves changing fabric's physical configuration and combining the fabric with other materials
Cotton fibre	A soft, downy, cellulosic fibre attached to the seeds of the cotton plant of the genus <i>Gossypium</i> ; mostly grown in warm climates
Coverstock	Lightweight material used to cover absorbent cores in medical or hygienic products
Creping	The finishing process of compressive shrinkage that imparts crimp, bulk, and a puckered surface
Cross-direction	Perpendicular to the direction in which a fabric moves through a machine
Crosslapper	A machine that continuously lays a web so that its fibres are oriented in a cross direction
Cross lapping or cross laying	The process of laying a web on a conveyor, moving at right angles so the web's fibres are oriented in a cross direction
Cross-linking	The process by which polymers form bonds between molecular chains, to form a three-dimensional polymeric network
Curing	Heating of resin or binder in or on fabrics to cause or complete a chemical reaction
Dryforming, drylaying	The process of making nonwoven webs from dry fibres via the carding or airlaying process
Elastomers	Elastic polymers
Embossing	The process of imparting a pattern in relief or three dimensions to a fabric surface
Emulsion	A system of finely divided liquid droplets dispersed in a second immiscible liquid
Entanglement	Web bonding method that wraps or knots individual fibres into an integrated structure; can be done mechanically (needling) or hydraulically (water jets; see also Hydroentangling)
Extrusion	The method by which molten polymer is forced through an orifice to form a fibre, film, sheet, shape, etc.
Felt	A fabric of fibres entangled by mechanical reorientation of some of the fibres within the structure; produced using barbed needles; also referred to as needlefelt
Fibre	Unit of matter, synthetic or natural, characterized by a high ratio of length-to-width
Fibrefill	Low-density fibrous structures used in apparel, bedding, and other products
Filament	A fibre of an indefinite length
Film	A thin, flexible sheet of plastic; a thin coating of liquid or solid. Finishing. Property-enhancing processes carried out after web is formed and bonded. Includes embossing, printing, creping, coating, etc.

Flocking	The process by which short fibres (0.1 mm) are applied to adhesive-coated nonwovens fabric to enhance the surface
Foam bonding	The process of applying latex binder to a web which has been inflated with air; provides a means to use a binder at low water and high binder-solids concentration levels in a stabilized foam
Geotextile	Fabric used in civil engineering applications to separate, reinforce soils for roads, dams, airfields, roofs; used in construction of water and waste disposal basins
Greige	Unfinished fabric; also grey or gray fabric
Hand	Tactile properties of a fabric related to softness, elasticity, and drapability
Heat setting	The process of stabilizing the structure and shape of fibres or fabrics by applying heat
Highloft	Describes low-density, bulky fabrics; (noun) a fabric with low-density and bulkiness
Hydroentangling	The web bonding process using high-velocity water jets to wrap or knot individual fibres; also referred to as jet lacing, spunlacing
Hydrophilic	Showing affinity for water-fabrics having this property will absorb water or wet easily
Hydrophobic	Lacking affinity for water-fabrics having this property will not absorb water or wet easily
Industrial fabrics	Fabrics used in applications other than hygiene, apparel, medical, and home furnishings
Interlining	.Fabric used between inner and outer layers of apparel to impart weight or stiffness, shape retention, warmth, and bulk to the garment
Isotropic	Physical properties are the same in every direction in a material's plane; usually achieved through random-laid fibres
Jet lacing	See Hydroentangling
Laminate	A combined material made up of two or more layers bonded together with essentially no intermingling at the interface
Laminating	The process of making a layered material without intermingling at the interface
Mechanical finishing	Using a mechanical process to alter aesthetic or functional properties of a web
Meltblowing	A method of forming fabric from thermoplastic resins; the resin is melted, extruded, and blown with fast-moving air that stretches or attenuates the fibres, which are then condensed and collected
Meltspinning	A method of passing melted, liquid polymer through spinnerets and coagulating the material in a cold air stream
Monomer	A chemical compound that can be polymerized to form a chain of such units; see Polymer
Napping	Mechanically raising fibres to the surface of lubricated fabric by withdrawing fibres from the interior
Needlepunching	A physical method of mechanically interlocking fibre webs by using barbed needles to reposition some of the fibres from a horizontal to a vertical orientation (also called Needlefelting)
Nonwoven	A fabric consisting of an assembly of textile fibres (oriented in one direction or in a random manner) held together (1) by mechanical interlocking; (2) by fusing of thermoplastic fibres, or (3) by bonding with a rubber, starch, glue, casein, latex, or a cellulose derivative or synthetic resin

Nylon fibre	A manmade fibre in which the fibre-forming substance is any family of long-chain molecules that contains the recurring amide group (-NH-CO-). The two principle nylons are nylon 6 (polycaprolactam) and nylon 6,6 (polyhexamethylenediamine adipamide). Due to nylon fibre's strength and flexibility, it is used for industrial and high-performance nonwoven specialty fabrics
Opening	Preliminary operation in the processing of staple fibre
Permeation	The absorption and diffusion of gases or liquids through materials
Plastic	Any of the various materials that may be fabricated into shape or form by the application of heat and pressure; can be natural or synthetic
Plasticiser	A chemical which gives flexibility, workability, or stretchability to polymers and resins
Ply	A layer of a fabric, web, or sheet
Point bonding	The process of binding thermoplastic fibres in a nonwoven web by applying heat and pressure in a discrete pattern
Polymer	A high molecular weight, chemical chain formed by linking together molecular units called monomers; the structural material of many types of fibres; can be natural or synthetic
Polyester fibre	A manmade fibre in which the fibre-forming substance is any long chain synthetic polymer composed of at least 85% by weight of an ester of dihydric alcohol and terephthalic acid [C <sub>6</sub> H <sub>4</sub> (COOH) <sub>2</sub> ]. The most common polyester (PET) polymer is made by reacting ethylene glycol and terephthalic acid (or its derivatives). PET fibres show high strength and are shrink- and stretch-resistant. Suitable nonwovens applications include floor coverings, fibrefill, automotive, and industrial products
Polyethylene (PE) fibre	A manmade fibre made of ethylene (a petroleum derivative; C <sub>2</sub> H <sub>4</sub> ) which is polymerized and then meltspun. Due to its low moisture regain, mildew- and insect-resistance, PE is used for geotextiles, outdoor furniture, packaging, and industrial applications
Polypropylene (PP) fibre	A manmade olefin fibre made from polymers or copolymers of propylene (a petroleum derivative; C <sub>3</sub> H <sub>6</sub> ) and is produced via meltspinning. Due to its high resistance to mechanical abuse and chemical attack, PP fibres often are used in geotextiles, carpet, automotive, upholstery, filtration, protective clothing, and industrial applications
Print bonding	Process of applying adhesive binding only to predetermined areas of a nonwoven web in a pattern
Pulp	A soft, moist, slightly cohering mass; usually refers to liquid slurry of woodpulp fibre and water
Quenching	After extrusion, the cooling of filaments using highly controlled air flow with regulated temperature to solidify filament
Rayon fibre	A manmade fibre that is composed of cellulose derived from wood pulp, cotton linters, or other plant matter; produced by converting cellulose into unstable chemical derivative (xanthate) dissolving in caustic solution to form viscose spinning solution, extruding into an acid solution bath to regenerate cellulose in desired form
Saturation bonding	The bonding process that involves immersing web in a binder bath or flooding the web with binder as it enters pressure rolls
Scrim	A porous web that frequently is used to reinforce web or sheet structures
Shearing	Mechanical finishing process that cuts raised fibres to uniform heights
Spinnerette	Perforated plate through which polymer or solution is extruded to make fibre

Spray bonding	The process of applying atomized binder to a nonwoven web; followed by drying
Spunbonding	The process of forming fabric by layering continuous filaments on a forming screen and bonding
Spunlacing	See Hydroentangling
Staple fibres	Fibres cut to specific lengths; also refers to natural fibres produced with relatively short length
Stitchbonding	The mechanical method of combining fibre webs by using a knitting stitch and a yarn or yarn-like fibre tuft
Strikethrough	The process by which a resin permeates through the back of an interlining during the fusing step
Structure punching	Formation of a looped surface structure to nonwoven fabric using hooked needles
Substrate	Material to which fabrics, coatings, or other materials are applied
Sueding	Mechanical finishing process in which fibres on the surface of a fabric are cut by the abrasive action of a sanding roll operating at high speed
Superabsorbent	A material (powder, polymer, fibre) that is capable of absorbing substantial amounts of liquid
Tear strength	Force required to cause a tear in a fabric under specific conditions
Tensile strength	The greatest stress or load a material can bear without breaking
Thermal bonding, Thermobonding	The process of binding by applying heat to a web of thermoplastic fibres or a web impregnated with meltable powders or thermoplastic fibres
Thermoplastic	A plastic that melts upon heating
Ticking	Strong fabric used as a covering for mattresses, pillows, and upholstery
Tow	A twist-free bundle of continuous filaments
Ultrasonic bonding	Bonding thermoplastic fibres via a high frequency mechanical movement which generates localized heat through the vibration; also referred to as sonic bonding
Velour	A fabric finish characterised by a soft fibrous surface
Web	Preferentially arranged assembly or sheet of fibres; see Batt
Wetforming, wetlaying	Process of forming a web by dispersing fibres in a aqueous medium and collecting them on a screen or perforated drum
Wetting agent	Agent which enhances the wettability of a material or surface, and helps to spread liquid on the surface
Wicking	Transport of liquid by capillary action within a fibrous material
Woodpulp	Short, cellulosic fibres derived from wood; a raw material for rayon fibre; used to form paper

