Title: IMPROVED ABRASION RESISTANCE OF NONWOVENS

Abstract: An extruded web material comprises a conjugate fiber including first and second fiber portions. The first fiber portion extends substantially continuously along the length of the conjugate fiber and comprises a first thermoplastic polymeric material. The second fiber portion extends substantially continuously along the length of the conjugate fiber and defines at least a portion of a conjugate fiber exterior surface. The second fiber portion comprises a second thermoplastic polymeric material. At least one of the first fiber portion or the second fiber portion further comprises a thermoplastic adhesive component. The extruded web material is produced by spunbonding or meltblowing. The extruded web material can also be included in a composite article.
IMPROVED ABRASION RESISTANCE OF NONWOVEN

FIELD OF THE INVENTION

This invention relates generally to extruded web materials. More particularly, the present invention relates to a method of producing an extruded web material comprising a fiber or filament wherein the fiber or filament includes a thermoplastic adhesive component and to the extruded web material made thereby.

BACKGROUND OF THE INVENTION

Staple fibers are fibers used for nonwoven web formation that have a typical length of 0.6 cm to 20 cm. Nonwoven fabrics made from staple fibers have been in use for several decades. These nonwovens are formed by processing staple fibers using carding, or air forming techniques, depositing them on a forming wire and using a bonding technique such as thermal bonding, hydro-entangling or needle-punching to form a bonded web. Short staple fibers may also be used in a wet forming process, where water is used as a medium to disperse pulp and short cut staple fibers into a slurry, which is then deposited on a forming wire to form a nonwoven web. A variety of short binder fibers can be used to impart heat bondable properties to nonwoven webs made from staple fibers.

In the spunbonding and meltblowing processes, nonwoven web materials are formed directly from extruded polymers doing away with the need cut fibers to staple lengths and subsequently card, air form or water form the staple fibers into a nonwoven web. The spunbonding process generally uses a heated extruder that supplies melted polymer to a spinneret where the polymer is converted to filaments, forming a vertically oriented curtain of downward advancing filaments. The filaments are partially cooled in a quench chamber, usually with chilled air, reaching a temperature suitable for the next stage of the process. A drawing unit (or attenuator) located below the quench chamber creates a drawing force on the partly cooled filaments, causing them to be attenuated or stretched to a large degree. The filaments exit the bottom of the attenuator unit where they are deposited on a forming element, usually a moving, porous, conveyor belt, to form a batt of substantially continuous filaments. The batt is accumulated, generally in roll form. Typically, the filaments extend the length of the batt, which may be hundreds or thousands of
meters in length. After deposition on the forming element, some or all of the filaments in the batt may be joined to each other through conventional techniques such as thermal bonding to form a nonwoven web material.

The melt blown process forms fibers by extruding molten thermoplastic polymer through a plurality of fine, usually circular, die capillaries as molten threads or filaments into converging heated, high velocity gas (e.g. air) streams which attenuate the filaments of molten thermoplastic material to reduce their diameter, generally to micron or sub-micron dimensions. Thereafter, the meltblown filaments are carried by the high velocity gas stream and are deposited on a forming surface to form a batt of randomly dispersed meltblown fibers. The batt is accumulated, generally in roll form. Meltblown fibers are substantially continuous when deposited onto the forming surface and typically extend the length of the batt, which may be hundreds or thousands of meters in length. After cooling, some or all of the fibers in the batt may be joined to each other through web consolidation techniques with or without the use of heat.

Thermal bonding holds the nonwoven web material together by bonding fibers or filaments within the fabric. Thermal bonding techniques include passing a collection of fibers to be bonded between heated calender rolls. One of the calender rolls is usually, though not always, patterned in some way so that the entire fabric is not bonded across its entire surface. This technique is known as thermal point bonding or thermal pattern bonding. As a result, various patterns for calender rolls have been developed for functional as well as aesthetic reasons. Typically, the percent bonded area for pattern bonding varies from around 5% to around 50% of the area of the nonwoven web material. One example of a thermal point bond pattern has points with about a 30% bond area and about 200 bonds/square inch.

Spunbonded fabrics made from single polymer fibers may not provide the desired combination of properties. For example, spunbonded fabrics consisting of polyester fibers are strong, high temperature stable and radiation sterilizable for medical applications but they do not offer a high degree of softness. Spunbonded fabrics consisting of polyethylene fibers tend to be soft to the touch, drapeable and have a pleasant hand, but generally suffer from low strength properties and poor abrasion resistance. Therefore, spunbonded fabrics have been produced using conjugate fibers or filaments, to provide a fabric having a more desirable combination
of properties. Conjugate fibers or filaments are formed from at least two separate polymer sources extruded from separate extruders but spun together to form a single fiber or filament. The extruded polymers are located, by means of the internal design of the spinning equipment, in substantially constantly positioned distinct zones across the cross-section of the conjugate fiber or filament and extend substantially continuously along the length of the conjugate fiber or filament.

Bicomponent fibers of the sheath:core type containing polyethylene at the surface generally retain the poor abrasion resistance of monocomponent polyethylene fibers. Thermally bonded, nonwoven web materials comprising such mono- or bicomponent fibers or filaments incorporating polyethylene similarly tend to similarly suffer from poor abrasion resistance. Thus, there remains a need for a more abrasion resistant nonwoven material comprising polyethylene fibers.

DEFINITIONS

Bicomponent fiber or filament - Conjugate fiber or filament that has been formed by extruding polymer sources from separate extruders and spun together to form a single fiber or filament. Typically, two separate polymers are extruded, although a bicomponent fiber or filament may encompass extrusion of the same polymeric material from separate extruders. The extruded polymers are arranged in substantially constantly positioned distinct zones across the cross-section of the bicomponent fibers or filaments and extend substantially continuously along the length of the bicomponent fibers or filaments. The configuration of bicomponent fibers or filaments can be symmetric (e.g., sheath:core or side:side) or they can be asymmetric (e.g., offset core within sheath; crescent moon configuration within a fiber having an overall round shape). The two polymer sources may be present in ratios of, for example (but not exclusively), 75/25, 50/50 or 25/75.

Conjugate fiber or filament - Fiber or filament that has been formed by extruding polymer sources from separate extruders and spun together to form a single fiber or filament. A conjugate fiber encompasses the use of two or more separate polymers each supplied by a separate extruder. The extruded polymers are arranged in substantially constantly positioned distinct zones across the cross-section of the conjugate fiber or filament and extend substantially continuously along the length of the conjugate fiber or filament. The shape of the conjugate fiber or
filament can be any shape that is convenient to the producer for the intended end use, e.g., round, trilobal, triangular, dog-boned, flat or hollow.

Cross machine direction (CD) - The direction perpendicular to the machine direction.

Denier - A unit used to indicate the fineness of a filament given by the weight in grams for 9,000 meters of filament. A filament of 1 denier has a mass of 1 gram for 9,000 meters of length.

Extruded web material - A nonwoven sheet material formed by the spunbond or meltblown process. As used herein an extruded web material excludes nonwoven web materials made from staple fibers using wet laid, air laid or carding processes. The extruded web material can comprise one or more layers and can comprise post-formation treatments.

Fiber - A material form characterized by an extremely high ratio of length to diameter. As used herein, the terms fiber and filament are used interchangeably unless otherwise specifically indicated.

Filament - A substantially continuous fiber. As used herein, the terms fiber and filament are used interchangeably unless otherwise specifically indicated.

Machine direction (MD) - The direction of travel of the forming surface onto which fibers or filaments are deposited during formation of a nonwoven web material.

Meltblown fiber - A fiber formed by extruding a molten thermoplastic material as filaments from a plurality of fine, usually circular, die capillaries into a high velocity gas (e.g., air) stream which attenuates the filaments of molten thermoplastic material to reduce their diameter. Thereafter, the meltblown fibers are carried by the high velocity gas stream and are deposited on a collecting surface to form a web of randomly dispersed meltblown fibers. Meltblown fibers are generally continuous. The meltblown process includes the meltspray process.

Non-thermoplastic polymer - Any polymer material that does not fall within the definition of thermoplastic polymer.

Nonwoven fabric, sheet or web - A material having a structure of individual fibers which are interlaid, but not in an identifiable manner as in a woven or knitted fabric. Nonwoven materials have been formed from many processes such as, for example, meltblowing, spunbonding, carding and water laying processes. The basis weight of nonwoven fabrics is usually expressed in grams per square meter (gsm)
and the fiber fineness is measured in denier.

Polymer - A long chain of repeating, organic structural units. Generally includes, for example, homopolymers, copolymers, such as for example, block, graft, random and alternating copolymers, terpolymers, etc, and blends and modifications thereof. Furthermore, unless otherwise specifically limited, the term "polymer" includes all possible geometrical configurations. These configurations include, for example, isotactic, syndiotactic and random symmetries.

Spunbond filament – A filament formed by extruding molten thermoplastic materials from a plurality of fine, usually circular, capillaries of a spinneret. The diameter of the extruded filaments is then rapidly reduced as by, for example, eductive drawing and/or other well-known spunbonding mechanisms. Spunbond fibers are generally continuous with deniers within the range of about 0.1 to 5 or more.

Spunbond nonwoven web – Webs formed (usually) in a single process by extruding at least one molten thermoplastic material as filaments from a plurality of fine, usually circular, capillaries of a spinneret. The filaments are partly quenched and then drawn out to reduce fiber denier and increase molecular orientation within the fiber. The filaments are generally continuous and not tacky when they are deposited onto a collecting surface as a fibrous batt. The fibrous batt is then bonded by, for example, thermal bonding, chemical binders, mechanical needling, hydraulic entanglement or combinations thereof, to produce a nonwoven fabric.

Staple fiber - A fiber that has been formed at, or cut to, staple lengths of generally one quarter to eight inches (0.6 to 20 cm). Staple fibers and the use of staple fibers are not encompassed by the present invention.

Tex - A unit used to indicate the fineness of a filament given by the weight in grams for 1,000 meters of filament. A filament of 1 tex has a mass of 1 gram for 1,000 meters of length.

Thermoplastic polymer - A polymer that is fusible, softening when exposed to heat and returning generally to its unsoftened state when cooled to room temperature. Thermoplastic materials include, for example, polyvinyl chlorides, some polyesters, polyamides, polyfluorocarbons, polyolefins, some polyurethanes, polystyrenes, polystyrene alcohol, copolymers of ethylene and at least one vinyl monomer (e.g., poly (ethylene vinyl acetates), and acrylic resins.
SUMMARY OF THE INVENTION

An object of the invention is to provide an extruded web material having enhanced adhesion between the fiber components.

A further object of the invention is to provide a nonwoven web material extruded from spunbond filaments or meltblown fibers and having enhanced abrasion resistance properties.

Still another object of the invention is to provide an abrasion resistant, nonwoven web material extruded from at least one of bicomponent spunbond filaments or bicomponent meltblown fibers wherein the filaments or fibers have an outer portion comprising polyethylene in combination with a thermoplastic adhesive component overlying a polyethylene terephthalate core.

In brief, one aspect of the present invention is an extruded web material having a sheet-like form with opposing faces. The inventive extruded web material is produced by extrusion of conjugate fibers using either a spunbond or a meltblown process. The inventive extruded web material provides equivalent or enhanced strength and enhanced abrasion resistance as compared to nonwoven materials produced from similar fibers without the thermoplastic adhesive component.

The conjugate fiber useful in the inventive extruded web material comprises a first fiber portion extending substantially continuously along the length of the conjugate fiber. The first fiber portion is comprised of a first thermoplastic polymer material and comprises about 30% to about 90% by weight of the fiber. The conjugate fiber also comprises a second fiber portion generally adjacent to the first fiber portion. At least some of the second fiber portion defines the conjugate fiber outer surface. The second fiber portion is comprised of a second thermoplastic polymer material and comprises about 10% to about 70% by weight of the fiber. The second fiber portion typically has a lower melting point than the first thermoplastic material. Conjugate fibers useful in the inventive extruded web material may comprise an additional fiber portion or portions extending substantially continuously along the length of the conjugate fiber. Polymers useful as the first and/or second thermoplastic polymer material generally have a process melting point or temperature of between about 80 °C to about 320 °C (176 °F to 610 °F).
Copolymers and/or blends of the polymers useful as the first and/or second thermoplastic polymer material may also be used.

At least one of the fiber portions also includes a thermoplastic adhesive component. The thermoplastic adhesive component functions to enhance adhesion between at least some of the fiber portions in a conjugate fiber. In some embodiments wherein the second fiber portion comprises the thermoplastic adhesive component, that component functions to enhance adhesion between overlying fibers in the extruded web material. In embodiments where a thermoplastic adhesive component is added to more than one fiber portion, the thermoplastic adhesive component and amount added to each fiber portion is independent of the thermoplastic adhesive component and amount added to the other fiber portions.

In one advantageous bicomponent fiber embodiment, the first portion comprises a core of polyethylene terephthalate. The second fiber portion is a sheath comprising at least about 50% by weight of polyethylene and no more than about 50% by weight of a thermoplastic adhesive component. In this embodiment, the thermoplastic adhesive component can be selected from poly(ethylene vinyl acetate) (EVA), polyvinyl alcohol (PVOH), poly(ethylene vinyl alcohol) (EVOH), a copolymer of one of the polymers and mixtures thereof.

Another aspect of the invention is a method of making an extruded web material comprising fibers including a thermoplastic adhesive component using a spunbonding or meltblowing process.

A further aspect of the invention is an inventive composite sheet comprising at least one inventive extruded web material substantially attached to at least one substrate in a face to face orientation. The inventive composite sheet may also comprise multiple inventive extruded web materials attached to multiple substrates. The inventive extruded web material and substrates may be arranged in any desired order to provide the composite sheet. The inventive extruded web material is advantageously attached to the substrate by thermal bonding due to the thermoplastic adhesive component, although other types of adhesive bonding and mechanical joining are also encompassed by the invention.

In general, unless otherwise explicitly stated the material of the invention may be alternately formulated to comprise, consist of, or consist essentially of, any appropriate components herein disclosed. The material of the invention may
Additionally, or alternatively, be formulated so as to be devoid, or substantially free, of any components, materials, ingredients, adjuvants or species used in the prior art compositions or that are otherwise not necessary to the achievement of the function and/or objectives of the present invention.

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BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the invention will become apparent from the specification and the drawings in which:

Figures 1 through 5 are illustrations of illustrations of reference standards 1 through 5, respectively, for the Abrasion Test described herein.

DETAILED DESCRIPTION OF THE INVENTION

The inventive extruded web materials comprise conjugate fibers having a denier between about 0.1 and about 30 although this will depend on the desired properties of the fibers and the specific application in which they are to be used. For simplicity, these conjugate fibers will generally be described with reference to a bicomponent fiber embodiment having first and second portions unless otherwise specifically indicated. It should be understood that the invention encompasses the use of conjugate fibers including more than two fiber portions and the addition of a thermoplastic adhesive component to any or all of the conjugate fiber portions. It should also be understood that the invention encompasses a composite sheet of two or more inventive extruded web materials.

The shape of the conjugate fibers can be any which is convenient to the producer for the intended end use, e.g., round, trilobal, triangular, dog-boned, flat or hollow. Some exemplary configurations of the inventive conjugate fibers include symmetric (e.g., sheath:core or side-by-side) or asymmetric (e.g., offset core within sheath; crescent moon configuration within a fiber having an overall round shape).

A first fiber portion extends substantially along the length of the conjugate fiber. The first fiber portion is comprised of a first thermoplastic polymer material.

Some suitable materials for the first fiber portion include polyethylene terephthalate, a mixture of polyethylene terephthalate polymers with similar or modified chemistries (for example CHDM (1,4-cyclohexanediolmethanol) modified polyethylene terephthalate), polylactic acid (PLA), other polyesters such as polybutylene
terephthalate (PBT) and poly trimethylene terephthalate (PTT), polypropylene, polyamide, copolymers of any of these polymers or mixtures thereof. The first fiber portion comprises about 30% to about 90% by weight of the fiber.

A second fiber portion is generally adjacent to the first fiber portion. The second fiber portion is comprised of a second thermoplastic polymer material. In some advantageous embodiments, the second thermoplastic polymer material comprises a polyethylene polymer. The second fiber portion comprises about 10% to about 70% by weight of the fiber and comprises at least a portion of the conjugate fiber exterior surface. The second fiber portion typically has a lower melting point than the first fiber portion.

At least one of the first or second fiber portions also includes a thermoplastic adhesive component. The thermoplastic adhesive component functions to enhance adhesion between the first and second fiber portions and also between fibers in a nonwoven web. In embodiments where a thermoplastic adhesive component is added to both the first and second portions, the thermoplastic adhesive component and amount added to the first fiber portion may be independently selected from the thermoplastic adhesive component and amount added to the second fiber portion. The same thermoplastic adhesive component and amount may be added to both fiber portions.

Materials suitable for use as a thermoplastic adhesive component include, for example, poly(ethylene vinyl acetate) (EVA), poly(vinyl alcohol) (PVOH), poly(ethylene vinyl alcohol) (EVOH), a copolymer of one of the polymers and mixtures thereof. Advantageously, the thermoplastic adhesive component comprises poly(ethylene vinyl acetate) (EVA), poly(vinyl alcohol) (PVOH), poly(ethylene vinyl alcohol) (EVOH) or mixtures thereof.

Ethylene vinyl acetate copolymers are a group of resins having a unique combination of flexibility, toughness and clarity. These copolymers are characterized by the amount of vinyl acetate incorporated in the copolymer and provide excellent heat sealability, and broad heat sealing range properties. Incorporating ethylene vinyl acetate copolymers with polyethylene in the sheath of a sheath:core fiber increases the adhesion between the sheath and the core components thus preventing these components from separating from each other in an abrasive environment. The use of such bicomponent fibers also improves abrasion resistance
of the resulting extruded web material by improving fiber-to-fiber bonding or adhesion.

The amount of thermoplastic adhesive component that may be incorporated into the fiber portion is dependent on many variables, including processing equipment and processing parameters, although it is believed that use of more than about 50% by weight of thermoplastic adhesive component will lead to processing problems. Thermoplastic adhesive component amounts of about 5% to about 10% (EVA) by sheath weight have been found to provide noticeable advantages in the resulting extruded web material.

Additionally, the first fiber portion and/or the second fiber portion may contain one or more independently selected processing additives, including, for example, coloring pigments, opacifying pigments, functional additives such as a hydrophilic agents, antistatic agents and mixtures thereof.

In one advantageous embodiment, the conjugate fiber is a melt-spun bicomponent filament. The first fiber portion comprises a core of polyethylene terephthalate polymer or mixture of polyethylene terephthalate polymers with similar or modified chemistries. The first fiber portion comprises about 30% to about 90% of the conjugate fiber weight. The second fiber portion is a sheath overlying the core. The second fiber portion comprises about 10% to about 70% of the conjugate fiber weight. The second fiber portion comprises at least about 50% by weight of a polyethylene polymer, or mixture of polyethylene polymers, and no more than about 50% by weight of a thermoplastic adhesive component. The thermoplastic adhesive component is selected from poly(ethylene vinyl acetate) (EVA), poly(vinyl alcohol) (PVOH), poly(ethylene vinyl alcohol) (EVOH), a copolymer of any of these polymers and mixtures thereof.

A further aspect of the invention is a method of making the inventive extruded web material. The thermoplastic adhesive component in the form of polymer pellets is mixed with base polymer pellets in a desired ratio using a gravimetric blender to provide a feedstock for the first and/or second fiber portion. Alternatively, the thermoplastic adhesive component can be melted and mixed with melted base polymer. The mixture can be cooled and broken up to form a feedstock wherein each pellet is comprised of a mixture of thermoplastic adhesive component and base
polymer. Other feedstocks without the thermoplastic adhesive component are prepared as needed for the remaining fiber portions.

Each fiber portion feedstock is fed to, and processed through, a separate heated extruder to melt and thoroughly blend the polymers. The temperature of each extruder is independent of the other extruders. Therefore, very different polymers can be used as adhesive components in the first and second fiber portions.

The resulting melted polymer blends for the first and second fiber portions pass through fine openings in the spinneret where the feedstocks are converted to filaments, forming a vertically oriented curtain of downward advancing filaments. The spinneret temperature is set according to the highest melting temperature polymer component. For a brief period all polymers are subjected to this temperature. However, by maintaining a through put rate of about 0.4 grams/hole/minute or more, the residence time of the polymers at the high spinneret temperature can be reduced to minimize the possibility of polymer degradation.

The thermoplastic adhesive component containing filaments pass through a quench chamber where they are partly cooled. A drawing unit (or attenuator) located below the quench chamber forms a rapidly moving downstream of air, drawing the partly cooled filaments with it. The rapidly moving air stream creates a drawing force on the partly cooled filaments, causing them to be attenuated or stretched. The filaments exit the bottom of the attenuator unit where they are deposited on a moving forming surface to form a batt of substantially continuous filaments. The thermoplastic adhesive component in the filaments may cause them to stick to each other and the equipment during quenching and attenuation and interfere with the subsequent deposition. Care should be taken during quenching and attenuation to prevent the filaments from sticking to each other and from sticking to the equipment. The batts can be bonded by, for example, thermal point bonding or through air bonding to form the inventive extruded web material. The inventive extruded web material is advantageously employed at basis weights of about 7 gsm to about 500 gsm.

The inventive nonwoven web materials may be subjected to additional processing to improve properties such as abrasion resistance. Such additional means may include options such as heat treatment of the nonwoven web material.
using patterned or non-patterned, heated calender rolls, application of a binder agent to the nonwoven web material, and combinations thereof.

Another potential advantage of adding a thermoplastic adhesive component in the sheath may be realized in the ability of the inventive extruded web material to more easily attach to other substrates such as other nonwovens, foam, film or textiles compared to a similar nonwoven which does not comprise fibers including a thermoplastic adhesive component. Such an attribute will be especially useful when the inventive extruded web material is used as a component of a laminate or composite sheet comprising multiple attached layers. Thus another aspect of the invention is an inventive composite sheet comprising at least one inventive extruded web material substantially attached to at least one substrate in a face to face orientation. Each substrate can be independently selected from a nonwoven material, a foam material, a film and a textile. The nonwoven material can include can include, for example, wet-laid, carded or spunlaced fabrics. The films can include, for example, mono or co-extruded films of polyethylene, polypropylene, polyester, co-polyester, nylon, poly(ethylene vinyl acetate), poly(ethylene methyl acrylate) and copolymers of these materials. The inventive extruded web material and substrate are overlaid and attached, advantageously by applying heat, such as by thermal point bonding due to the thermoplastic adhesive component, to form the inventive composite sheet. The inventive extruded web material and substrate can also be attached by adhesive lamination using a water based adhesive, a solvent based adhesive or a hot melt adhesive followed by application of heat. The inventive composite sheet may also comprise multiple inventive extruded web materials attached to multiple substrates. The inventive extruded web materials and substrates may be arranged in any desired order to provide the composite sheet.

Abrasion resistance of a nonwoven fabric can be measured by a variation of the test described in ASTM D3886 (1992) using the Stoll Abrasion Test Apparatus. In this test variation, a dry test specimen of nonwoven fabric is rubbed in a circular motion against a standard abradant cloth for 100 revolutions under a load of 2.5 pounds weight. The test specimen is removed, compared against reference samples, and given a rating between 0 (no abrasion apparent) and 5 (high degree of abrasion with thin area(s) or hole(s) present in the specimen). Figures 1 to 5
illustrate examples of ratings 1 to 5 respectively. Usually both sides of the test fabric are tested with a separate test specimen being used for each side.

Tensile strength of a nonwoven fabric can be measured by the Grab Tensile Strength Test (ASTM D5034 (1995)). This test measures the maximum tensile force developed in a test specimen that is carried to rupture when only a portion of the specimen is gripped within the clamping jaws.

It should be understood that the following examples are included for purposes of illustration so that the invention may be more readily understood and are in no way intended to limit the scope of the invention unless otherwise specifically indicated.

Comparative Sample

a) PET resin: Eastman F61HC, dried at about 280 °F for at least 6 hours.
b) PE resin: Dow Aspun 6842A.
c) Thermoplastic adhesive component - none
d) Spinneret: sheath:core type, about 4000 spin holes/meter width.
e) PET processing temperature: about 295 °C.
f) PE processing temperature: about 215 °C.
g) Spinneret temperature: about 295 °C.
h) Quench air temperature: about 10 °C.
i) PE sheath was about 40% of total filament weight.
j) Combined resin throughput (PE plus PET) was about 0.6 grams/hole/minute.
l) Line speed: about 100m/min.
m) Nonwoven fabric basis weight: about 25 gsm.

Example 1

a) PET resin: Eastman F61HC, dried at about 280 °F for at least 6 hours.
b) PE resin: Dow Aspun 6842A.
c) Thermoplastic adhesive component- EVA: Exxon LD755.12 @ 5% addition level in the sheath.
d) Spinneret: sheath:core type, about 4000 spin holes/meter width.
e) PET processing temperature: about 295 °C.

f) PE processing temperature: about 215 °C.

g) Spinneret temperature: about 295 °C.

h) Quench air temperature: about 10 °C.

i) PE sheath was about 40% of total filament weight.

j) Combined resin throughput (PE + PET) was about 0.6 grams/hole/minute.


l) Line speed: about 100m/min.

m) Nonwoven fabric basis weight: about 25 gsm.

Example 2

a) PET resin: Eastman F61HC, dried at about 280 °F for at least 6 hours.

b) PE resin: Dow Aspun 6842A.

c) Thermoplastic adhesive component - EVA: Exxon LD 755.12 @ 10% addition level in the sheath.

d) Spinneret: sheath:core type, about 4000 spin holes/meter width.

e) PET processing temperature: about 295 °C.

f) PE processing temperature: about 215 °C.

g) Spinneret temperature: about 295 °C.

h) Quench air temperature: about 10 °C.

i) PE sheath was about 40% of total filament weight.

j) Combined resin throughput (PE + PET) was about 0.6 grams/hole/minute.


l) Line speed: about 100m/min.

m) Nonwoven fabric basis weight: about 25 gsm.

Extruded web materials produced as the Comparative Sample and Examples 1-2 were tested for various properties. Table 1 summarizes some of the test results for the nonwoven web materials of Comparative Sample, and Examples 1 and 2.
Table 1 Nonwoven Material

<table>
<thead>
<tr>
<th>Fibers Used</th>
<th>Comparative Sample</th>
<th>Example 1</th>
<th>Example 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>core material</td>
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<td>polyethylene</td>
<td>polyethylene</td>
</tr>
<tr>
<td></td>
<td>terephthalate</td>
<td>terephthalate</td>
<td>terephthalate</td>
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<tr>
<td>sheath:core ratio</td>
<td>40:60</td>
<td>40:60</td>
<td>40:60</td>
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<tr>
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<td>polyethylene</td>
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<td>polyethylene</td>
</tr>
<tr>
<td>thermoplastic</td>
<td>none</td>
<td>5% (w/w)</td>
<td>10% (w/w)</td>
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<td>addition in sheath</td>
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<td>EVA</td>
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</tr>
<tr>
<td></td>
<td>basis weight (gsm)</td>
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Stoll Abrasion

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<th>Side</th>
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<th>Example 2</th>
</tr>
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<tbody>
<tr>
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</tr>
<tr>
<td>side B</td>
<td>3.5</td>
<td>2.5</td>
</tr>
</tbody>
</table>

Grab Tensile Strength

<table>
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<tr>
<th></th>
<th>Example 1</th>
<th>Example 2</th>
<th>Example 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD (lb.)</td>
<td>22.6</td>
<td>24.8</td>
<td>22.6</td>
</tr>
<tr>
<td>CD (lb.)</td>
<td>11.3</td>
<td>12.9</td>
<td>12.1</td>
</tr>
</tbody>
</table>

Surprisingly, for a given basis weight, the inventive extruded web materials of Examples 1 and 2, produced from fibers including a thermoplastic adhesive component comprising EVA, exhibited significantly improved abrasion resistance without adversely impacting other web material properties. The tensile strength of the inventive extruded web materials of Examples 1 and 2 was the same as, or better than, the tensile strength of the Comparative Sample web material.

While preferred embodiments of the foregoing invention have been set forth for purposes of illustration, the foregoing description should not be deemed a limitation of the invention herein. Accordingly, various modifications, adaptations and
alternatives may occur to one skilled in the art without departing from the spirit and scope of the present invention.
WHAT IS CLAIMED IS:

1. An extruded web material comprising a conjugate fiber including a first fiber portion extending substantially continuously along the length of the conjugate fiber and comprising a first thermoplastic polymeric material and a second fiber portion extending substantially continuously along the length of the conjugate fiber and defining at least a portion of a conjugate fiber exterior surface, the second fiber portion comprising a second thermoplastic polymeric material, wherein at least one of the first fiber portion or the second fiber portion further comprises a thermoplastic adhesive component selected from poly(ethylene vinyl acetate), polyvinyl alcohol, poly(ethylene vinyl alcohol), a copolymer of one of the polymers or mixtures thereof.

2. The extruded web material claim 1 wherein the conjugate fiber is a substantially continuous spunbond filament.

3. The extruded web material of claim 1 where the conjugate fiber is a substantially continuous meltblown fiber.

4. The nonwoven fabric of claim 1, wherein the first fiber portion comprises of about 30% to about 90% by weight of the conjugate fiber, and the second fiber portion comprises about 70% to about 10% by weight of the conjugate fiber.

5. The nonwoven fabric of claim 1, wherein at least one of the first fiber portion or the second fiber portion is comprised of less than about 50% by weight of the thermoplastic adhesive component.

6. The nonwoven fabric of claim 1, wherein at least one of the first fiber portion or the second fiber portion is comprised of less than about 30% by weight of the thermoplastic adhesive component.

7. The nonwoven fabric of claim 1, wherein the first fiber portion comprises polyethylene terephthalate, polybutylene terephthalate, poly trimethylene
terephthalate, polylactic acid, polypropylene, polyamide, a copolymer of one of these polymers or mixtures thereof.

8. The nonwoven fabric of claim 1 having improved abrasion resistance properties compared to a nonwoven fabric of the same conjugate fiber composition without the thermoplastic adhesive component.

9. The nonwoven fabric of claim 1, wherein the second fiber portion comprises a polyolefin.

10. A method of making a nonwoven web material, comprising:
    providing a first thermoplastic feedstock and a second thermoplastic feedstock;
    mixing no more than about 50% by weight of a thermoplastic adhesive component selected from poly(ethylene vinyl acetate), polyvinyl alcohol, poly(ethylene vinyl alcohol), a copolymer of one of the polymers or mixtures thereof with at least one of the first feedstock or the second feedstock;
    extruding the first feedstock and the second feedstock to form a conjugate fiber, the first feedstock forming a first fiber portion extending substantially continuously along the length of the conjugate fiber and the second feedstock forming a second fiber portion extending substantially continuously along the length of the conjugate fiber and defining at least a portion of the conjugate fiber exterior surface;
    depositing the fiber on a forming surface to form a batt; and
    bonding the batt to form the nonwoven web material.

11. The method of claim 10, including the step of subjecting the nonwoven web material to an additional process to improve abrasion resistance.

12. The method of claim 10 wherein the first feedstock comprises polyethylene terephthalate, a mixture of polyethylene terephthalate polymers, polybutylene terephthalate, poly trimethylene terephthalate, polylactic acid, polypropylene, polyamide, or mixtures thereof; the second feedstock comprises polyethylene or a
mixture of polyethylene polymers; and the thermoplastic adhesive component consists essentially of poly(ethylene vinyl acetate).

13. A composite article, comprising:

An extruded web material layer comprising a conjugate fiber including, a first fiber portion extending substantially continuously along the length of the conjugate fiber and comprising a first polymeric material; and a second fiber portion extending substantially continuously along the length of the conjugate fiber and defining at least a portion of the conjugate fiber exterior surface, the second fiber portion comprising a second polymeric material, wherein at least one of the first fiber portion or the second fiber portion further includes a thermoplastic adhesive component selected from poly(ethylene vinyl acetate), polyvinyl alcohol, poly(ethylene vinyl alcohol), a copolymer of one of the polymers or mixtures thereof; and

a substrate layer substantially attached to the extruded web material.

14. The composite article of claim 13 wherein the substrate layer is selected from a nonwoven material, a woven material, a foam material and a film material.

16. The composite article of claim 13 comprising three or more layers.

17. The composite article of claim 13 wherein the extruded web material layer is attached to the substrate layer by adhesive bonding.

18. The composite article of claim 13 wherein the extruded web material layer is attached to the substrate layer by heat bonding.

19. An extruded web material comprising a conjugate fiber, the conjugate fiber including a first fiber portion comprising about 30% to about 70% of the conjugate fiber weight and extending substantially continuously along the length of the conjugate fiber, the first fiber portion selected from polyethylene terephthalate, polybutylene terephthalate, poly trimethylene terephthalate, polyactic acid, polypropylene, polyamide and a second fiber portion comprising about 10% to about 70% of the conjugate fiber weight and extending substantially continuously along the
length of the conjugate fiber and defining at least a portion of a conjugate fiber exterior surface, the second fiber portion comprising polyethylene, wherein at least one of the first fiber portion or the second fiber portion further comprises less than about 50% by weight of a thermoplastic adhesive component consisting essentially of poly(ethylene vinyl acetate) polymer.
INTERNATIONAL SEARCH REPORT
International application No. PCT/US03/15311

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : B32B 27/12; D04H 1/58, 13/00
US CL : 442/148,327,361,400,401,415; 264/464
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
U.S. : 442/148,327,361,400,401,415; 264/464

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Please See Continuation Sheet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category *</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>US 5,662,978 A (BROWN et al) 02 September 1997 (02.09.1977), see entire document.</td>
<td>1-19</td>
</tr>
<tr>
<td>Y,P</td>
<td>US 6,458,726 A (HARRINGTON et al) 01 October 2002 (01.10.2002), see entire document.</td>
<td>1-19</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:
- "A": document defining the general state of the art which is not considered to be of particular relevance
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