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(54) Title: ELASTIC NONWOVENS WITH IMPROVED HAPTICS AND MECHANICAL PROPERTIES

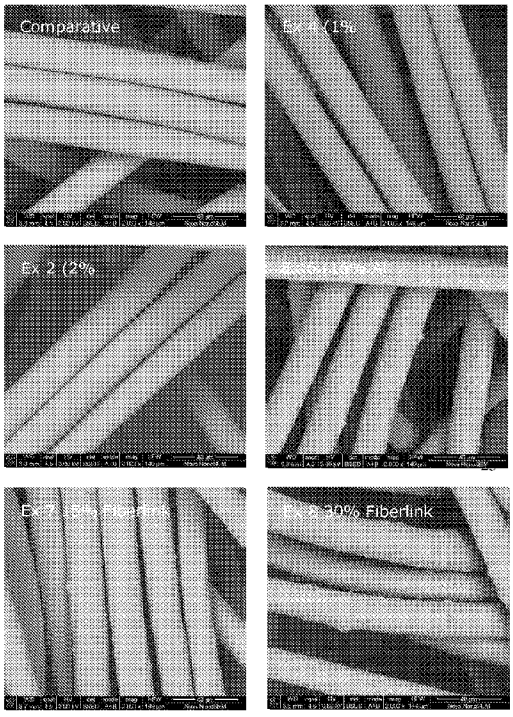

Figure 1

(57) Abstract: The present invention is an extensible nonwoven comprising a polyolefin elastomer fiber wherein the surface of the fiber further comprises an inorganic filler or PDMS or combinations thereof, wherein the inorganic filler, if present, has D-90 particle size of 5 microns or less.

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ELASTIC NONWOVENS WITH IMPROVED HAPTICS AND MECHANICAL PROPERTIES

FIELD OF INVENTION

The present invention relates to nonwoven fabrics having improved haptics while maintaining mechanical performance

BACKGROUND AND SUMMARY OF INVENTION

Propylene-based polymers, particularly homo-polypropylene (hPP) are well known in the art, and have long been used in the manufacture of fibers. Fabrics made from hPP, particularly nonwoven fabrics, exhibit high modulus but poor elasticity. These fabrics are commonly incorporated into multicomponent articles, e.g., diapers, wound dressings, feminine hygiene products and the like. While polyethylene-based elastomers, and the fibers and fabrics made from these polymers, exhibit low modulus and good elasticity, they also exhibit poor tenacity, stickiness and hand feel which are generally considered to be unacceptable for commercial applications.

Tenacity is important because the manufacture of multicomponent articles typically involves multiple steps (e.g., rolling/unrolling, cutting, adhesion, etc.). Fibers with a high tensile strength are advantaged over fibers with a low tensile strength because the former will experience fewer line breaks (and thus greater productivity). Moreover, the end-use typically requires a level of tensile strength specific to the function of the component. Optimized fabrics have the minimum material consumption (basis weight) to achieve the minimum required tensile strength for the manufacture and end-use of the fiber, component (e.g., nonwoven fabric) and article.

Low modulus is one aspect of hand feel. Fabrics made from fibers with a low modulus will feel "softer", all else equal, than fabrics made from fibers with a high modulus. A fabric comprised of lower modulus fibers will also exhibit lower flexural rigidity which translates to better drapability and better fit. In contrast, a fabric made from a higher modulus fiber, e.g., hPP, will feel harsher (stiffer) and will drape less well (e.g., it will have a poorer fit). However, fabrics made from polyethylene-based elastomers tend to feel tacky and clammy to the skin.

Fiber elasticity is also important because it translates to better comfort-fit as the article made from the fiber will be more body conforming. Diapers with elastic components

will have less sagging in general as body size and shape and movement vary. With improved fit, the general well being of the user is improved through improved comfort, reduced leakage and a closer resemblance of the article to cotton underwear.

Most elastomeric materials have been characterized as having an undesirable rubbery touch or waxy feel. Not surprisingly, elastic nonwoven fabrics made from such materials also possess texture that is perceived by end-users and sticky, rubbery or waxy.

Thus new nonwoven fabrics are desired which are extensible, durable, and have improved haptics. It has been discovered that using olefin based elastomers with different additives improved the perceptions of materials without unduly affecting the mechanical performance of the fabrics. Accordingly, in one aspect, the present invention is an extensible nonwoven comprising a polyolefin elastomer fiber wherein the surface of the fiber further comprises an inorganic filler or PDMS or combinations thereof, wherein the inorganic filler, if present, has D-90 particle size of 5 microns or less.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a set of SEM images of nonwovens with different fillers according the present invention

DETAILED DESCRIPTION OF THE INVENTION

As used herein, the term "nonwoven web" or “nonwoven fabric” or “nonwoven”, refers to a web that has a structure of individual fibers or threads which are interlaid, but not in any regular, repeating manner. Nonwoven webs have been formed by a variety of processes, such as, for example, air laying processes, meltblowing processes, spunbonding processes and carding processes, including bonded carded web processes.

As used herein, the term "meltblown" , refers to the process of extruding a molten thermoplastic material through a plurality of fine, usually circular, die capillaries as molten threads or filaments into a high velocity gas (e.g., air) stream which attenuates the filaments of molten thermoplastic material to reduce their diameter, which may be to a microfiber 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.

As used herein, the term "spunbonded", refers to the process of extruding a molten thermoplastic material as filaments from a plurality of fine, usually circular, capillaries of a

spinneret with the diameter of the extruded filaments then being rapidly reduced by drawing the fibers and collecting the fibers on a substrate.

As used herein, the term "microfibers", refers to small diameter fibers having an average diameter not greater than about 100 microns. Fibers, and in particular, spunbond and meltblown fibers used in the present invention can be microfibers. More specifically, the spunbond fibers can advantageously be fibers having an average diameter of about 14-28 microns, and having a denier from about 1.2-5.0, whereas the meltblown fibers can advantageously be fibers having an average diameter of less than about 15 microns, or more advantageously be fibers having an average diameter of less than about 12 microns, or even more advantageously be fibers having an average diameter of less than about 10 microns. It also contemplated that the meltblown fibers may have even smaller average diameters, such as less than 5 microns.

As used herein, the term "polymer" generally includes, but is not limited to, 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" shall include all possible geometrical configurations of the material. These configurations include, but are not limited to, isotactic, syndiotactic and random symmetries.

“Polyethylene” shall mean polymers comprising greater than 50% by weight of units which have been derived from ethylene monomer. This includes polyethylene homopolymers or copolymers (meaning units derived from two or more comonomers). Common forms of polyethylene known in the art include Low Density Polyethylene (LDPE); Linear Low Density Polyethylene (LLDPE); Medium Density Polyethylene (MDPE); and High Density Polyethylene (HDPE). These polyethylene materials are generally known in the art; however the following descriptions may be helpful in understanding the differences between some of these different polyethylene resins

The term “LDPE” may also be referred to as "high pressure ethylene polymer" or "highly branched polyethylene" and is defined to mean that the polymer is partly or entirely homopolymerized or copolymerized in autoclave or tubular reactors at pressures above 14,500 pounds per square inch (psi) [100 megapascals (MPa)] with the use of free-radical initiators, such as peroxides (see for example US 4,599,392, herein incorporated by reference). LDPE resins typically have a density in the range of 0.916 to 0.940 grams per cubic center (g/cm^3).

"LLDPE" refers to linear ethylene alpha olefin copolymers having a density in the range of from about 0.855 about 0.912 g/cm^3 to about 0.925 g/cm^3. "LLDPE" may be made using chromium, Ziegler-Natta, metallocene, constrained geometry, or single site catalysts. The term "LLDPE" includes znLLDPE, uLLDPE, and mLLDPE. "znLLDPE" refers to linear polyethylene made using Ziegler-Natta or chromium catalysts and typically has a density of from about 0.912 to about 0.925 g/cm^3 and a molecular weight distribution greater than about 2.5, "uLLDPE" or "ultra linear low density polyethylene" refers to linear polyethylene having a density of less than 0.912 g/cm^3, but which is made using chromium or Ziegler-Natta catalysts and thus typically have a molecular weight distribution ("MWD") greater than 2.5. "mLLDPE" refers to LLDPE made using metallocene, constrained geometry, or single site catalysts. These polymers typically have a molecular weight distribution ("MWD") in the range of from 1.5 to 8.0. These resins will typically have a density in the range of from about 0.855 to 0.925 g/cm^3. The alpha olefin monomer to be copolymerized with the ethylene monomer is preferably an alpha olefin having from 3 to 20 carbon atoms. Preferred copolymers include 1-hexene and 1-octene.

"MDPE" refers to linear polyethylene having a density in the range of from greater than 0.925 g/cm^3 to about 0.940 g/cm^3. "MDPE" is typically made using chromium or Ziegler-Natta catalysts or using metallocene, constrained geometry, or single cite catalysts, and typically have a molecular weight distribution ("MWD") greater than 2.5.

"HDPE" refers to linear polyethylene having a density in the range greater than or equal to 0.940 g/cm^3. "HDPE" is typically made using chromium or Ziegler-Natta catalysts or using metallocene, constrained geometry, or single cite catalysts and typically have a molecular weight distribution ("MWD") greater than 2.5.

"Polypropylene" shall mean polymers comprising greater than 50% by weight of units which have been derived from propylene monomer. This includes homopolymer polypropylene, random copolymer polypropylene, impact copolymer polypropylene, and propylene based plastomers and elastomers. These polypropylene materials are generally known in the art.

As used herein, the term "polypropylene based plastomers (PBP) or elastomers (PBE)" (collectively, these may be referred to as "PBPE") includes reactor grade copolymers of propylene having heat of fusion less than about 100 Joules/gram (J/g) as measured using differential scanning Calorimetry (DSC) and MWD < 3.5. The PBPs

generally have a heat of fusion less than about 100 J/g while the PBEs generally have a heat of fusion less than about 40 J/g. The PBPs typically have a weight percent ethylene in the range of about 3 to about 10 weight percent (wt%) ethylene, with the elastomeric PBEs having an ethylene content of from about 10 to 15 wt% ethylene.

As used herein, the term "extensible" refers to any nonwoven material which, upon application of a biasing force, is able to undergo elongation to at least about 50 percent strain and more preferably at least about 70 percent strain without experiencing catastrophic failure.

As used herein, the term "tensile strength" describes the peak force for a given basis weight when pulled in either the machine direction (MD) or cross direction (CD) of a nonwoven when pulled to break. The peak force may or may not correspond to the force at break or strain at break. "Elongation" unless otherwise specified, refers to the strain corresponding to the tensile strength.

The following analytical methods are used in the present invention:

Density is determined in accordance with ASTM D792.

"Melt index" also referred to as "MI" or "I_2" is determined according to ASTM D1238 (190°C, 2.16 kg). "Melt flow rate" or "MFR" is determined according to ASTM D1238 (230°C, 2.16 kg). Melt index is generally associated with polyethylene polymers, while melt flow rate is associated with propylene based polymers

"Softness" is determined using the Handle-o-meter (manufactured by Edana, part number WSP 90.3 (05)). The method uses 10x10 cm, min 3 samples, a slit width of 5 mm, and an arm weight of 100 grams. Measurements are done in machine direction (MD) and cross-direction stiffness (CD), and reported as combination or for specific direction.

"D-90" refers to the Particle Size at which 90% of the particles in a cumulative particle size distribution will be less than or equal to the value. Thus in a particle size distribution having a D-90 of 5 microns, 90% of the particles will have a particle size of 5 microns or less.

"Particle Size"- dynamic light scattering (DLS) is used for accurately determining the particle size distribution according to ISO 22412:2008 which specifies a method for the application of DLS to the estimation of an average particle size and the measurement of the broadness of the size distribution as well as the D10, D50 and D90 of mainly sub

micrometer-sized particles or droplets dispersed in liquids.

Differential scanning calorimetry (DSC) is a common technique that can be used to examine the melting and crystallization of semi-crystalline polymers. General principles of DSC measurements and applications of DSC to studying semi-crystalline polymers are described in standard texts (e.g., E. A. Turi, ed., *Thermal Characterization of Polymeric Materials*, Academic Press, 1981). Certain of the copolymers of this invention are characterized by a DSC curve with a T_m that remains essentially the same and a T_{max} that decreases as the amount of unsaturated comonomer in the copolymer is increased. Tm (or alternatively T_{me}) means the temperature at which the melting ends. T_{max} means the peak melting temperature.

Differential Scanning Calorimetry (DSC) analysis is determined using a model Q1000 DSC from TA Instruments, Inc. Calibration of the DSC is done as follows. First, a baseline is obtained by running the DSC from -90°C to 290°C without any sample in the aluminum DSC pan. Then 7 milligrams (mg) of a fresh indium sample is analyzed by heating the sample to 180°C, cooling the sample to 140°C at a cooling rate of 10°C/min followed by keeping the sample isothermally at 140°C for 1 minute, followed by heating the sample from 140°C to 180°C at a heating rate of 10°C/min. The heat of fusion and the onset of melting of the indium sample are determined and checked to be within 0.5°C from 156.6°C for the onset of melting and within 0.5 J/g from 28.71 J/g for the heat of fusion. Then deionized water is analyzed by cooling a small drop of fresh sample in the DSC pan from 25°C to -30°C at a cooling rate of 10°C/min. The sample is kept isothermally at -30°C for 2 minutes and heated to 30°C at a heating rate of 10°C/min. The onset of melting is determined and checked to be within 0.5°C from 0°C.

The samples are pressed into a thin film at a temperature of 190°C. About 5 to 8 mg of sample is weighed out and placed in the DSC pan. The lid is crimped on the pan to ensure a closed atmosphere. The sample pan is placed in the DSC cell and the heated at a high rate of about 100 degrees Celsius per minute (°C/min) to a temperature of about 30 60°C above the melt temperature. The sample is kept at this temperature for about 3 minutes. Then the sample is cooled at a rate of 10°C/min to -40°C, and kept isothermally at that temperature for 3 minutes. Consequently the sample is heated at a rate of 10°C/min until complete melting. The resulting enthalpy curves are analyzed for peak melt temperature, onset and peak crystallization temperatures, heat of fusion and heat of

crystallization, Tme, and any other DSC analyses of interest.

Molecular weight and molecular weight distributions of the propylene-alpha olefin copolymers are determined using gel permeation chromatography (GPC) on a Polymer Laboratories PL-GPC-220 high temperature chromatographic unit equipped with four linear mixed bed columns (Polymer Laboratories (20-micron particle size)). The oven temperature is at 160°C with the autosampler hot zone at 160°C and the warm zone at 145°C. The solvent is 1,2,4-trichlorobenzene containing 200 ppm 2,6-di-t-butyl-4-methylphenol. The flow rate is 1.0 milliliter/minute and the injection size is 100 microliters. About 0.2% by weight solutions of the samples are prepared for injection by dissolving the sample in nitrogen purged 1,2,4-trichlorobenzene containing 200 ppm 2,6-di-t-butyl-4-methylphenol for 2.5 hrs at 160°C with gentle mixing.

The molecular weight determination is deduced by using ten narrow molecular weight distribution polystyrene standards (from Polymer Laboratories, EasiCal PS1 ranging from 580 - 7,500,000 g/mole) in conjunction with their elution volumes. The equivalent propylene-alpha olefin copolymer molecular weights are determined by using appropriate Mark-Houwink coefficients for polypropylene (as described by Th.G. Scholte, N.L.J. Meijerink, H.M. Schoffeleers, and A.M.G. Brands, *J. Appl. Polym. Sci.*, **29**, 3763 - 3782 (1984)) and polystyrene (as described by E. P. Otocka, R. J. Roe, N. Y. Hellman, P. M. Muglia, *Macromolecules*, **4**, 507 (1971)) in the Mark-Houwink equation:

$$\{N\} = KMa$$

where Kpp = 1.90E-04 , app = 0.725 and Kps = 1.26E-04, aps = 0.702.

Standard CRYSTAF Method:

Branching distributions are determined by crystallization analysis fractionation (CRYSTAF) using a CRYSTAF 200 unit commercially available from PolymerChar, Valencia, Spain. The samples are dissolved in 1,2,4 trichlorobenzene at 160°C (0.66 mg/mL) for 1 hr and stabilized at 95°C for 45 minutes. The sampling temperatures range from 95 to 30°C at a cooling rate of 0.2°C/min. An infrared detector is used to measure the polymer solution concentrations. The cumulative soluble concentration is measured as the polymer crystallizes while the temperature is decreased. The analytical derivative of the cumulative profile reflects the short chain branching distribution of the polymer.

The CRYSTAF peak temperature and area are identified by the peak analysis

module included in the CRYSTAF Software (Version 2001.b, PolymerChar, Valencia, Spain). The CRYSTAF peak finding routine identifies a peak temperature as a maximum in the dW/dT curve and the area between the largest positive inflections on either side of the identified peak in the derivative curve. To calculate the CRYSTAF curve, the preferred processing parameters are with a temperature limit of 70°C and with smoothing parameters above the temperature limit of 0.1, and below the temperature limit of 0.3, analytical temperature-rising elution fractionation (ATREF) Peak Comonomer Composition Measurement by Infra-Red Detector. The comonomer composition of the temperature-rising elution fractionation (TREF) peak can be measured using an IR4 infra-red detector available from Polymer Char, Valencia, Spain (http://www.polymerchar.com/).

The "composition mode" of the detector is equipped with a measurement sensor (CH_2) and composition sensor (CH_3) that are fixed narrow band infra-red filters in the region of 2800-3000 cm^{-1}. The measurement sensor detects the methylene (CH_2) carbons on the polymer (which directly relates to the polymer concentration in solution) while the composition sensor detects the methyl (CH_3) groups of the polymer. The mathematical ratio of the composition signal (CH_3) divided by the measurement signal (CH_2) is sensitive to the comonomer content of the measured polymer in solution and its response is calibrated with known ethylene alpha-olefin copolymer standards.

The detector when used with an ATREF instrument provides both a concentration (CH_2) and composition (CH_3) signal response of the eluted polymer during the TREF process. A polymer specific calibration can be created by measuring the area ratio of the CH_3 to CH_2 for polymers with known comonomer content (preferably measured by NMR). The comonomer content of an ATREF peak of a polymer can be estimated by applying the reference calibration of the ratio of the areas for the individual CH_3 and CH_2 response (i.e. area ratio CH_3/ CH_2 versus comonomer content).

The area of the peaks can be calculated using a full width/half maximum (FWHM) calculation after applying the appropriate baselines to integrate the individual signal responses from the TREF chromatogram. The full width/half maximum calculation is based on the ratio of methyl to methylene response area [CH_3/ CH2] from the ATREF infra-red detector, wherein the tallest (highest) peak is identified from the base line, and then the FWHM area is determined. For a distribution measured using an ATREF peak, the FWHM area is defined as the area under the curve between T1 and T2, where T1 and T2 are points

determined, to the left and right of the ATREF peak, by dividing the peak height by two, and then drawing a line horizontal to the base line, that intersects the left and right portions of the ATREF curve.

The application of infra-red spectroscopy to measure the comonomer content of polymers in this ATREF-infra-red method is, in principle, similar to that of GPC/FTIR systems as described in the following references: Markovich, Ronald P.; Hazlitt, Lonnie G.; Smith, Linley; "Development of gel-permeation chromatography-Fourier transform infrared spectroscopy for characterization of ethylene-based polyolefin copolymers". *Polymeric Materials Science and Engineering* (1991), **65**, 98-100.; and Deslauriers, P.J.; Rohlfing, D.C.; Shieh, E.T.; "Quantifying short chain branching microstructures in ethylene-1-olefin copolymers using size exclusion chromatography and Fourier transform infrared spectroscopy (SEC-FTIR)", *Polymer* (2002), **43**, 59-170., both of which are incorporated by reference herein in their entirety.

Nonwoven

In one aspect, the present invention is an extensible nonwoven comprising a polyolefin elastomer fiber wherein the surface of the fiber further comprises an inorganic filler or PDMS or combinations thereof, wherein the inorganic filler, if present, has D-90 particle size of 5 microns or less.

The nonwoven web of the present invention is comprised of monocomponent or bicomponent fibers wherein the monocomponent or bicomponent fibers comprise an elastomer. An elastomer is defined to mean a polymer which has elastic properties. For purposes of the present invention the term "elastic" is used herein to mean any material which, upon application of a biasing force, is stretchable, that is, elongatable, to a stretched, biased length which is at least about 150 percent of its relaxed unbiased length, and which will recover at least 50 percent of its elongation upon release of the stretching, elongating force in less than one minute. A hypothetical example would be a one (1) inch sample of a material which is elongatable to at least 1.50 inches and which, upon being elongated to 1.50 inches and released, will recover to a length of not more than 1.25 inches in less than one minute. Many elastic materials may be stretched by much more than 50 percent of their relaxed length, for example, 80 percent or more, and many of these will recover to substantially their original relaxed length, for example, to within 105 percent of their original relaxed length, upon release of the stretching force.

The fibers which make up the nonwoven web may be monocomponent or bicomponent fibers. In either case, it is preferred that the surface of the fiber comprise an elastomeric material.

If bicomponent fibers are used, it is preferred that the fibers be in a sheath-core form, with the sheath comprising an elastomeric material. The core of such fibers may comprise homopolymer polypropylene (hPP), polyester or an elastomeric polymer. It is preferred that the sheath comprise from 10 to 50 percent by weight of the fiber.

It is also contemplated that the nonwoven web for uses in the structure of the present invention may comprise bicomponent staple fibers thermally bonded to a nonwoven web. The bicomponent staple fibers can be in a sheath-core form, with the sheath comprising an elastomeric material. The core of such fibers may comprise homopolymer polypropylene (hPP), polyester or an elastomeric polymer. It is preferred that the sheath comprise from 20 to 50 percent by weight of the fiber.

The fiber can be made from any polyolefin elastomer. Preferred elastomers include LLDPE having a density less than 0.905 g/cc, PBPEs, and olefin block copolymers (OBC). Preferred elastomeric LLDPEs are ethylene-octene copolymers having a density between 0.86 and 0.905 g/cm^3 and a melt index (MI, 2.16 kg @ 190°C) between 2 to 25 g/10 min, preferably between 5 and 15 g/10 min.

Preferred PBPEs are those comprising from 5 and 18 % of units derived from ethylene, preferably from 7 to 15%, more preferably from 8 to 12%, and a melt flow rate (MFR, 2.16 kg @ 230°C) of at least about 0.01, preferably at least about 0.05, more preferably at least about 1 and most preferably at least about 10. The maximum MFR typically does not exceed about 2,000, preferably it does not exceed about 1000, more preferably it does not exceed about 500, further more preferably it does not exceed about 80 and most preferably it does not exceed about 50. Preferred PBPEs have a relatively low crystallinity (or heat of fusion, ΔH), preferably in the range of 0 to 80 J/g, preferably from 15 to 65 J/g, more preferably from 30 to 60 J/g, a most preferably does not exceed about 50 J/g as measured by DSC.

The weight average molecular weight (Mw) of the preferred PBPEs of this invention can vary widely, but typically it is between about 10,000 and 1,000,000 g/mol (with the understanding that the only limit on the minimum or the maximum Mw is that set by practical considerations). For copolymers used in the manufacture of meltblown fibers,

preferably the minimum Mw is about 20,000 g/mol, more preferably about 25,000 g/mol as measured by GPC.

The polydispersity of the copolymers of this invention is typically between about 2 and about 4. "Narrow polydisperity", "narrow molecular weight distribution", "narrow MWD" and similar terms mean a ratio (Mw/Mn) of weight average molecular weight (Mw) to number average molecular weight (Mn) of less than about 3.5, preferably less than about 3.0, more preferably less than about 2.8, more preferably less than about 2.5, and most preferably less than about 2.3. Polymers for use in fiber applications typically have a narrow polydispersity. Blends comprising two or more of the copolymers of this invention, or blends comprising at least one copolymer of this invention and at least one other polymer, may have a polydispersity greater than 4 although for spinning considerations, the polydispersity of such blends is still preferably between about 2 and about 4.

PBPEs are a relatively new class of propylene/alpha-olefin copolymers which are further described in details in the U.S. Patent Nos. 6,960,635 and 6,525,157, incorporated herein by reference. Such propylene/alpha-olefin copolymers are commercially available from The Dow Chemical Company, under the tradename VERSIFY™, or from ExxonMobil Chemical Company, under the tradename VISTAMAXX™. Other suitable propylene-based polymers included TAFMER™ and NOTIO™ from Mitsui Chemicals Group and L-MODU™ from Idemitsu Kosan.

Olefin block copolymers (OBC), are a relatively new class of material which are more fully described in WO 2005/090427, US2006/0199931, US2006/0199930, US2006/0199914, US2006/0199912, US2006/0199911, US2006/0199910, US2006/0199908, US2006/0199907, US2006/0199906, US2006/0199905, US2006/0199897, US2006/0199896, US2006/0199887, US2006/0199884 (now US 7,514,517), US2006/0199872, US2006/0199744, US2006/0199030, US2006/0199006 and US2006/0199983; each publication being fully incorporated herein by reference. OBCs are commercially available from The Dow Chemical Company under the INFUSE™ trademark.

The multi-block polymers typically comprise various amounts of "hard" and "soft" segments. "Hard" segments refer to blocks of polymerized units in which ethylene is present in an amount greater than about 95 weight percent, and preferably greater than about 98 weight percent based on the weight of the polymer. In other words, the comonomer content (content of monomers other than ethylene) in the hard segments is less than about 5

weight percent, and preferably less than about 2 weight percent based on the weight of the polymer. In some embodiments, the hard segments comprise all or substantially all ethylene. "Soft" segments, on the other hand, refer to blocks of polymerized units in which the comonomer content (content of monomers other than ethylene) is greater than about 5 weight percent, preferably greater than about 8 weight percent, greater than about 10 weight percent, or greater than about 15 weight percent based on the weight of the polymer. In some embodiments, the comonomer content in the soft segments can be greater than about 20 weight percent, greater than about 25 weight percent, greater than about 30 weight percent, greater than about 35 weight percent, greater than about 40 weight percent, greater than about 45 weight percent, greater than about 50 weight percent, or greater than about 60 weight percent.

The soft segments can often be present in a block interpolymer from about 1 weight percent to about 99 weight percent of the total weight of the block interpolymer, preferably from about 5 weight percent to about 95 weight percent, from about 10 weight percent to about 90 weight percent, from about 15 weight percent to about 85 weight percent, from about 20 weight percent to about 80 weight percent, from about 25 weight percent to about 75 weight percent, from about 30 weight percent to about 70 weight percent, from about 35 weight percent to about 65 weight percent, from about 40 weight percent to about 60 weight percent, or from about 45 weight percent to about 55 weight percent of the total weight of the block interpolymer. Conversely, the hard segments can be present in similar ranges. The soft segment weight percentage and the hard segment weight percentage can be calculated based on data obtained from DSC or NMR as is generally known in the art, and referenced in US 7,514,517.

The term "crystalline" if employed, refers to a polymer that possesses a first order transition or crystalline melting point (Tm) as determined by differential scanning calorimetry (DSC) or equivalent technique. The term may be used interchangeably with the term "semicrystalline". The term "amorphous" refers to a polymer lacking a crystalline melting point as determined by differential scanning calorimetry (DSC) or equivalent technique.

The term "multi-block copolymer" or "segmented copolymer" refers to a polymer comprising two or more chemically distinct regions or segments (referred to as "blocks") preferably joined in a linear manner, that is, a polymer comprising chemically differentiated units which are joined end-to-end with respect to polymerized ethylenic functionality, rather

than in pendent or grafted fashion. In a preferred embodiment, the blocks differ in the amount or type of comonomer incorporated therein, the density, the amount of crystallinity, the crystallite size attributable to a polymer of such composition, the type or degree of tacticity (isotactic or syndiotactic), regio-regularity or regio-irregularity, the amount of branching, including long chain branching or hyper-branching, the homogeneity, or any other chemical or physical property. The multi-block copolymers are characterized by unique distributions of both polydispersity index (PDI or Mw/Mn), block length distribution, and/or block number distribution due to the unique process making of the copolymers. More specifically, when produced in a continuous process, the polymers desirably possess PDI from 1.7 to 2.9, preferably from 1.8 to 2.5, more preferably from 1.8 to 2.2, and most preferably from 1.8 to 2.1. When produced in a batch or semi-batch process, the polymers possess PDI from 1.0 to 2.9, preferably from 1.3 to 2.5, more preferably from 1.4 to 2.0, and most preferably from 1.4 to 1.8.

In another aspect, the olefin block copolymers are characterized by a ΔT, in degree Celsius, defined as the temperature for the tallest Differential Scanning Calorimetry ("DSC") peak minus the temperature for the tallest Crystallization Analysis Fractionation ("CRYSTAF") peak and a heat of fusion in J/g, ΔH, and ΔT and ΔH satisfy the following relationships:

$\Delta T > -0.1299(\Delta H) + 62.81$, and preferably

$\Delta T \geq -0.1299(\Delta H) + 64.38$, and more preferably

$\Delta T \geq -0.1299(\Delta H) + 65.95$,

for ΔH up to 130 J/g. Moreover, ΔT is equal to or greater than 48 °C for ΔH greater than 130 J/g.

In yet another aspect, the olefin block copolymers have a molecular fraction which elutes between 40°C and 130°C when fractionated using Temperature Rising Elution Fractionation ("TREF"), characterized in that said fraction has a molar comonomer content higher, preferably at least 5 percent higher, more preferably at least 10 percent higher, than that of a comparable random ethylene interpolymer fraction eluting between the same temperatures, wherein the comparable random ethylene interpolymer contains the same comonomer(s), and has a melt index, density, and molar comonomer content (based on the whole polymer) within 10 percent of that of the block interpolymer. Preferably, the Mw/Mn of the comparable interpolymer is also within 10 percent of that of the block

interpolymer and/or the comparable interpolymer has a total comonomer content within 10 weight percent of that of the block interpolymer.

In still another aspect, the olefin block copolymers are characterized by an elastic recovery, Re, in percent at 300 percent strain and 1 cycle measured on a compression-molded film of an ethylene/α-olefin interpolymer, and has a density, d, in grams/cubic centimeter, wherein the numerical values of Re and d satisfy the following relationship when ethylene/α-olefin interpolymer is substantially free of a cross-linked phase:

Re >1481-1629(d); and preferably

Re ≥1491-1629(d); and more preferably

Re ≥1501-1629(d); and even more preferably

Re ≥1511-1629(d).

Comonomer content may be measured using any suitable technique, with techniques based on nuclear magnetic resonance ("NMR") spectroscopy preferred. Moreover, for polymers or blends of polymers having relatively broad TREF curves, the polymer desirably is first fractionated using TREF into fractions each having an eluted temperature range of 10°C or less. That is, each eluted fraction has a collection temperature window of 10°C or less. Using this technique, said block interpolymers have at least one such fraction having a higher molar comonomer content than a corresponding fraction of the comparable interpolymer.

Preferably, for interpolymers of ethylene and 1-octene, the block interpolymer has a comonomer content of the TREF fraction eluting between 40 and 130°C greater than or equal to the quantity (- 0.2013) T + 20.07, more preferably greater than or equal to the quantity (-0.2013) T+ 21.07, where T is the numerical value of the peak elution temperature of the TREF fraction being compared, measured in °C.

In still another aspect, the olefin block copolymer is characterized by multiple blocks or segments of two or more polymerized monomer units differing in chemical or physical properties (blocked interpolymer), most preferably a multi-block copolymer, said block interpolymer having a molecular fraction which elutes between 40°C and 130°C, when fractionated using TREF increments, characterized in that every fraction having a comonomer content of at least about 6 mole percent, has a melting point greater than about 100°C. For those fractions having a comonomer content from about 3 mole percent to about 6 mole percent, every fraction has a DSC melting point of about 110°C or higher.

More preferably, said polymer fractions, having at least 1 mol percent comonomer, have a DSC melting point that corresponds to the equation:

$$T_m \geq (-5.5926)(\text{mol percent comonomer in the fraction}) + 135.90.$$

In yet another aspect, the olefin block copolymer is characterized by multiple blocks or segments of two or more polymerized monomer units differing in chemical or physical properties (blocked interpolymer), most preferably a multi-block copolymer, said block interpolymer having a molecular fraction which elutes between 40°C and 130°C, when fractionated using TREF increments, characterized in that every fraction that has an ATREF elution temperature greater than or equal to about 76°C, has a melt enthalpy (heat of fusion) as measured by DSC, corresponding to the equation:

Heat of fusion in Joules per gram (J/gm) $\leq (3.1718)$(ATREF elution temperature in Celsius) – 136.58,

The block interpolymers for use in the present invention have a molecular fraction which elutes between 40°C and 130°C, when fractionated using TREF increments, characterized in that every fraction that has an ATREF elution temperature between 40°C and less than about 76°C, has a melt enthalpy (heat of fusion) as measured by DSC, corresponding to the equation:

Heat of fusion (J/gm) $\leq (1.1312)$(ATREF elution temperature in Celsius) + 22.97.

In other embodiments, the inventive ethylene/α-olefin interpolymer is characterized by an average block index, ABI, which is greater than zero and up to about 1.0 and a molecular weight distribution, Mw/Mn, greater than about 1.3. The average block index, ABI, is the weight average of the block index ("BI") for each of the polymer fractions obtained in preparative TREF from 20°C and 110°C, with an increment of 5°C :

where BIi is the block index for the ith fraction of the inventive ethylene/α-olefin interpolymer obtained in preparative TREF, and wi is the weight percentage of the ith fraction.

For each polymer fraction, BI is defined by one of the two following equations (both of which give the same BI value):

or

where TX is the preparative ATREF elution temperature for the ith fraction (preferably expressed in Kelvin), PX is the ethylene mole fraction for the ith fraction, which can be measured by NMR or IR as described above. PAB is the ethylene mole fraction of

the whole ethylene/α-olefin interpolymer (before fractionation), which also can be measured by NMR or IR. TA and PA are the ATREF elution temperature and the ethylene mole fraction for pure "hard segments" (which refer to the crystalline segments of the interpolymer). As a first order approximation, the TA and PA values are set to those for high density polyethylene homopolymer, if the actual values for the "hard segments" are not available. For calculations performed herein, TA is 372°K, PA is 1.

TAB is the ATREF temperature for a random copolymer of the same composition and having an ethylene mole fraction of PAB. TAB can be calculated from the following equation:

$$\text{Ln PAB} = \alpha/\text{TAB} + \beta$$

where α and β are two constants which can be determined by calibration using a number of known random ethylene copolymers. It should be noted that α and β may vary from instrument to instrument. Moreover, one would need to create their own calibration curve with the polymer composition of interest and also in a similar molecular weight range as the fractions. There is a slight molecular weight effect. If the calibration curve is obtained from similar molecular weight ranges, such effect would be essentially negligible. In some embodiments, random ethylene copolymers satisfy the following relationship:

$$\text{Ln P} = -237.83/\text{TATREF} + 0.639$$

TXO is the ATREF temperature for a random copolymer of the same composition and having an ethylene mole fraction of PX. TXO can be calculated from $\text{LnPX} = \alpha/\text{TXO} + \beta$. Conversely, PXO is the ethylene mole fraction for a random copolymer of the same composition and having an ATREF temperature of TX, which can be calculated from $\text{Ln PXO} = \alpha/\text{TX} + \beta$.

Once the block index (BI) for each preparative TREF fraction is obtained, the weight average block index, ABI, for the whole polymer can be calculated. In some embodiments, ABI is greater than zero but less than about 0.3 or from about 0.1 to about 0.3. In other embodiments, ABI is greater than about 0.3 and up to about 1.0. Preferably, ABI should be in the range of from about 0.4 to about 0.7, from about 0.5 to about 0.7, or from about 0.6 to about 0.9. In some embodiments, ABI is in the range of from about 0.3 to about 0.9, from about 0.3 to about 0.8, or from about 0.3 to about 0.7, from about 0.3 to about 0.6, from about 0.3 to about 0.5, or from about 0.3 to about 0.4. In other embodiments, ABI is in the range of from about 0.4 to about 1.0, from about 0.5 to about

1.0, or from about 0.6 to about 1.0, from about 0.7 to about 1.0, from about 0.8 to about 1.0, or from about 0.9 to about 1.0.

Preferred elastomers for the fiber surface are propylene based plastomers or elastomers (PBPEs) and olefin block copolymers.

Additive

The material which makes up the fiber, used in the extensible nonwovens of the present invention further comprises an inorganic filler or PDMS or combinations thereof. The inorganic filler, if present, has D-90 particle size of 5 microns or less, more preferably 2 microns or less. Any inorganic filler known in the art can be used with this invention, however, for many applications it is preferred that the filler be selected from the group consisting of $CaCO_3$, $AlSiO_3$, talc, untreated or treated fused silica and combinations thereof. The amount of filler, when present, can vary depending on the type of filler used as well as the form of the fiber (that is whether the fiber is a monocomponent fiber or a bicomponent fiber). For monocomponent fibers with $CaCO_3$, it is generally preferred that the filler be added in an amount of from 1-15% by weight the fiber, more preferably from 5-8%. For bicomponent fibers with $CaCO_3$, it is generally preferred that the filler be added in an amount of from 5-50% by weight by weight of elastomeric materials used for the surface of the fiber of the fiber, more preferably from 15-30%. For monocomponent fibers with untreated fused silica, it is generally preferred that the filler be added in an amount of from 0.25% to 5% by weight the fiber, more preferably from 0.5-2%. For bicomponent fibers with aluminum silicate, it is generally preferred that the filler be added in an amount of from 5-30% by weight by weight of elastomeric materials used for the surface of the fiber of the fiber, more preferably from 15-20%. It is also contemplated that 2 or more fillers may be simultaneously used.

When polydimethylsiloxane (PDMS) is used, the PDMS used can be a hydroxyl-terminated, ultra high molecular weight poly(dimethylsiloxane) powder. The average particle size of the PDMS powders is between 2 and 5 microns . The formulated PDMS preferably has a molecular weight such that the material has a viscosity greater than 15 million cSt.

The PDMS is conveniently added to the polymer composition in the form of a masterbatch, in a polyethylene based carrier material, in an amount so that the final composition used for the material which will make up the surface of the fiber contains the desired amount. For monocomponent fibers it is generally preferred that the PDMS be

added in an amount of from .05 to 1% by weight of the fiber, preferably from 0.1 to 0.3%. For bicomponent fibers it is preferred that the PDMS be added in an amount of from 0.5 to 10% by weight of the material which makes up the surface of the fiber, preferably from 1 to 2%.

The PDMS can be added to the polymer in any way known to the art. The PDMS is ideally added prior to extrusion/fiber formation, but may be added after fiber formation, for example as a coating. Conveniently, the PDMS may be added to the polyolefin material via a masterbatch with additional polyolefin material as the carrier medium.

The PDMS may be used by itself or with one or more of the inorganic fillers described above.

The nonwoven fabrics of the present invention can be characterized in terms of a good balance of elongation, permanent set, and bending modulus while exhibiting the improved hand-feel characteristics.

EXAMPLES

The following resins are used to make a series of nonwoven fabrics:

Resin A is an ethylene 1-octene block copolymer elastomer having 15 g/10 min melt flow index (ASTM D1238, 190°C, 2.16 kg) and density of 0.866 g/cc (ASTM D792). The comonomer (1-octene) content the resin is as follows: ~ 18 mol.% in soft segment and < 1mol.% in hard segment. The hard segment content is ~ 25 wt.%.

Resin B is a higher density linear low density polyethylene having 17 g/10 min melt flow index (ASTM D1238, 190°C, 2.16 kg) and density of 0.955 g/cc (ASTM D792). The comonomer is 1-octene.

Several bico elastic/extensible nonwoven samples with core/sheath ratio of 90/10 (by weight) and having different amounts of additive C, D or E (as indicated below) in the sheath were prepared to show the effect of additives on hand-feel perception and mechanical properties of the elastic nonwovens. All samples are fabricated on a Reicofil 3 pilot plant line. The processing conditions and equipment details are summarized in Table 1, Table 2 and Table 3. The additives are described in Table 4. The fabricated samples are shown in Table 5.

Comparative example Ex 1: The core material was Resin A. The sheath material is 100% Resin B. The bonding temperature is 100°C.

Example 2: The core material is resin A and the sheath material was a blend of 96 wt% of resin B (same resin as used in Comp. Ex. 1) with 4 wt % masterbatch C and the bonding temperature is 100°C.

Example 3: Example 2 is repeated except that the bonding temperature is 110°C.

Example 4: Example 3 is repeated except that the sheath comprises 98 wt% of resin B and 2 wt % of the additive Masterbatch C.

Example 5: Example 4 is repeated except that the bonding temperature is 100°C.

Example 6: The core material is resin A, The sheath material was a blend of 60 wt% resin B and 40 wt % of masterbatch D. The bonding temperature was 100°C.

Example 7: The core material is resin A, The sheath material was a blend of 70 wt% resin B and 30 wt % of masterbatch E. The bonding temperature was 95°C.

Example 8: Example 7 is repeated except that the sheath comprises 40% resin A and 60% masterbatch E.

Example 9: Example 8 is repeated except that the bonding temperature is 100°C.

Table 1 Line details

	A1 Extruder	**A2 Extruder**
Type	Single screw, compression	Single screw, barrier
Diameter (mm)	100	80
Length (D)	25.5	30
Compression	3.75:1	-

Table 2 Spinnerete

Type	**# of holes**	**Hole diameter (mm)**	**L/D ratio**	**Length (mm)**
BICO	5297	0.6	4	1200

Table 3 Processing conditions

Output (kg/hour)	160
Quench air temperature (°C)	18-23
Cabine pressure (mbar)	20-15
Slot gap (mm)	18
Suction blower (%)	70
Temperature of the spinneret	230-235
Bonding temperature (°C)	95, 100, 110

Table 4 Masterbatches

Masterbatch	Additive	Composition	Comment	Provided by
MB C	PDMS (Polydimethylsiloxane)	40 of PDMSO wt.% masterbatch in Resin B	Ultrahigh MW	Dow Corning
MB D	POLESTAR 400 (Al Silicate)	40 wt.% of Al Silicate in Resin B	D90=1.5 µm	IMERYS
MB E	FiberLink 101S ($CaCO_3$)	50 wt.% Resin B	D90=3.5 µm	IMERYS

Table 5 Fabricated samples

Example	Additive in the sheath	Configuration	Core:	Sheath:	Bonding T, °C	GSM
Comparative Ex 1	0%	BICO 90/10	Resin A	RESIN B	100	20
Ex 2	2% PDMSO	BICO 90/10	Resin A	RESIN B + 4% MB C	100	20
Ex 3	2% PDMSO	BICO 90/10	Resin A	RESIN B + 4% MB C	110	20
Ex 4	1% PDMSO	BICO 90/10	Resin A	RESIN B + 2% MB C	100	20
Ex 5	1% PDMSO	BICO 90/10	Resin A	RESIN B + 2% MB C	110	20
Ex 6	16% Al Silicate	BICO 90/10	Resin A	RESIN B + 40% MB D	100	20
Ex 7	15% CaCO3	BICO 90/10	Resin A	RESIN B + 30% MB E	95	20
Ex 8	30% CaCO3	BICO 90/10	Resin A	RESIN B + 60% MB E	95	20
Ex 9	30% CaCO3	BICO 90/10	Resin A	RESIN B + 60% MB E	100	20

The tensile properties of the fabrics are measured using 5 cm wide strips with a 10 cm gauge length and a strain rate of 200%/min (20 cm/min) according to DIN 53857 (also labelled 42 ADC Std Tensile)

Permanent set of the samples are measured according to the same internal method; the data is being presented for comparative purposes.

Frank bending of the fabricated samples is conducted according to ASTM D747 standard.

Coefficient of friction (CoF) measurements of the nonwoven samples are done according to ISO 8295/95 standard.

Table 6 Maximum force (CD/MD) (20 gsm samples)

Fmax, N	MD		CD		Bonding T	GSM
	Force	σ	Force		°C	
Comparative Ex 1	3.4	0.15	2.1	0.33	100	20
Ex 2	3.3	0.14	1.8	0.16	100	20
Ex 3	3.0	0.17	1.8	0.11	110	20
Ex 4	3.5	0.41	2.2	0.31	100	20
Ex 5	3.2	0.1	1.9	0.24	110	20
Ex 6	4.2	0.44	2.4	0.23	100	20
Ex 7	5.2	0.42	3.0	0.2	95	20
Ex 8	3.8	0.14	2.5	0.1	95	20
Ex 9	5.1	0.26	2.8	0.24	100	20

Table 7 Elongation at F_{max} (CD/MD) (20 gsm samples)

Elongation at Fmax	MD		CD		Bonding T	GSM
	%	σ	%		°C	
Comparative Ex 1	145	9	197	30	100	20
Ex 2	145	12	187	24	100	20
Ex 3	110	8	170	16	110	20
Ex 4	150	23	210	33	100	20
Ex 5	120	6	172	33	110	20
Ex 6	130	11	182	21	100	20
Ex 7	175	14	220	23	95	20
Ex 8	140	8	200	9	95	20
Ex 9	200	6	220	16	100	20

Table 8 Permanent set (CD/MD) (20 gsm samples)

Permanent set	MD		CD		Bonding T	GSM
	%	σ	%		°C	
Comparative Ex 1	36	1	42	2	100	20
Ex 2	37	2	44	1	100	20
Ex 3	39	1	42	2	110	20
Ex 4	34	4	43	1	100	20
Ex 5	41	1	43	1	110	20
Ex 6	32	1	40	1	100	20
Ex 7	32	1	35	2	95	20
Ex 8	31	1	37	3	95	20
Ex 9	30	1	34	2	100	20

Table 9 Frank bending (Fmax –CD/MD (70 gsm samples)

Frank bending -Fmax	MD	CD	Bonding T	GSM
	N	N	°C	
Comparative Ex 1	11.7	8.5	100	20
Ex 2	5.6	4.0	100	20
Ex 3	7.2	4.4	110	20
Ex 4	7.1	5.5	100	20
Ex 5	8.4	6.5	110	20
Ex 6	8.3	5.8	100	20
Ex 7	7.6	5.5	95	20
Ex 8	8.2	6.4	95	20
Ex 9	7.3	6.4	100	20

Table 10 Coefficient of Friction (Outside/Metal and Outside/Outside) (20 gsm samples) (note that a value of '1' indicates that the sample is completely blocked)

CoF	NW/NW	NW/Metal	Bonding T	GSM
			°C	
Comparative Ex 1	1	1	100	20
Ex 2	0.38	0.76	100	20
Ex 3	0.43	0.67	110	20
Ex 4	0.46	0.72	100	20
Ex 5	0.58	0.88	110	20
Ex 6	0.7	0.34	100	20
Ex 7	0.7	0.46	95	20
Ex 8	0.81	0.57	95	20
Ex 9	0.77	0.57	100	20

SENSORY PANEL - ATTRIBUTE WAXY

The fabricated samples are submitted to a Sensory Science Lab for smoothness, thermal, stiffness, tensile stretch (CD/MD) and waxy analysis

Handfeel of nonwoven fabrics was evaluated by human sensory panel. The panel consists of Dow employees who have been trained for the sense of touch. The ranking method is used to evaluate attributes.

Between 18 and 20 panelists were participated in each panel session. Each attribute is analyzed using an F-statistic in Analysis of Variance (ANOVA) to determine if there are any significant differences among the samples in the multiple comparisons. The F-ratio in the ANOVA indicates samples to be significantly different, so a Fisher's Least Significant Difference (LSD) is calculated to determine One-at-a-Time multiple comparisons. The

Fisher's LSD test is used for pairwise comparisons when a significant F-value has been obtained

The bonded side of the nonwoven fabrics is evaluated.

ATTRIBUTE WAXY

Technique: A sample is laid flat on the counter top. Each of the panelist moves his/her finger across the surface of the sample using the weight of his/her hand and forearm.

Sample preparations: The attribute is analyzed using a nonwoven fabric sheet (21 x 14.5 cm^2)

Anchors/Controls for attribute Waxy:

Waxy		
Rating Scale Value	*Fabric Type*	*Source*
2.0	AFFINITY™ LLDPE non-woven	Produced by Dow Chemical
9.3	Filament nylon 6 tricot-bright	Testfabrics ID #322
13.0	100% pre-shrunk cotton	Hanes Her Way for Girls

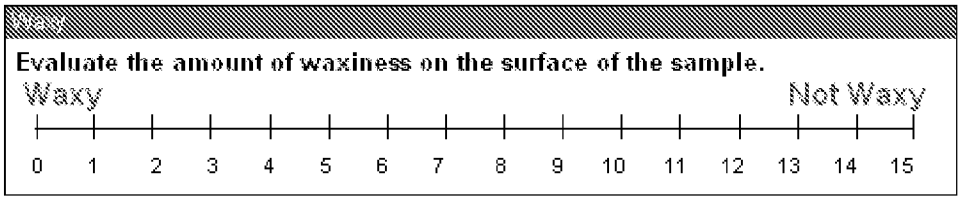

Table 11 Samples used for sensory panel evaluation

Example	Additive in the sheath	Configuration	Core:	Sheath:	Bonding T, °C	GSM
Comparative Ex 1	0%	BICO 90/10	Resin A	RESIN B	100	20
Ex 2	2% PDMSO	BICO 90/10	Resin A	RESIN B + 4% MB C	100	20
Ex 4	1% PDMSO	BICO 90/10	Resin A	RESIN B + 2% MB C	100	20
Ex 6	16% Al Silicate	BICO 90/10	Resin A	RESIN B + 40% MB D	100	20
Ex 7	15% CaCO3	BICO 90/10	Resin A	RESIN B + 30% MB E	95	20
Ex 8	30% CaCO3	BICO 90/10	Resin A	RESIN B + 60% MB E	95	20

Sample	*Mean*	*Group*	*Significantly Different Than Sample*
Example 6 (16 % Al Silicate)	7.44	A	Comparative example, Example 7, Example 8
Example 4 (1 % PDMS)	7.35	A B	Comparative example, Example 7, Example 8
Example 2 (2% PDMS)	7.02	A B	Comparative example, Example 7, Example 8
Comparative example	5.93	C	Example 7,Example 8
Example 7 (15% $CaCO_3$)	4.87	D	Example 7
Example 8 (30% $CaCO_3$)	3.59	E	

SEM analysis

NOVA Nansen 600 – FEI with accelerating voltage of 3 kV). The cross sectional cut of the fibers was done with a microtone (ULTRACUT S FCS - REICHERT-LEICA) and specimens were stained with RuO4 vapor. The results are shown in Figure 1.

WHAT IS CLAIMED IS:

1. An extensible nonwoven comprising a polyolefin elastomer fiber wherein the surface of the fiber further comprises an inorganic filler or PDMS or combinations thereof, wherein the inorganic filler, if present, has D-90 particle size of 5 microns or less.
2. The extensible nonwoven of claim 1 wherein the inorganic filler, if present, has D-90 particle size of 2 microns or less.
3. The extensible nonwoven of claim 1 wherein the polyolefin elastomer is selected from the group consisting of propylene based plastomers or elastomers (PBPEs) and olefin block copolymers (OBCs).
4. The extensible nonwoven of claim 1 wherein the inorganic filler is present and is selected from the group consisting of $CaCO_3$, $AlSiO_3$, talc, and untreated fused silica.
5. The extensible nonwoven of claim 1 wherein the fiber is a monocomponent fiber and $CaCO_3$ is present in an amount of from 1 to 15 % by weight of the fiber.
6. The extensible nonwoven of claim 1 wherein the fiber is a monocomponent fiber and untreated fused silica is present in an amount of from 0.25 to 5 % by weight of the fiber.
7. The extensible nonwoven of claim 1 wherein the fiber is a bicomponent fiber in the form of sheath/core and $CaCO_3$ is present in an amount of from 5 to 50 percent by weight of the sheath.
8. The extensible nonwoven of claim 1 wherein the fiber is a bicomponent fiber in the form of sheath/core and $AlSiO_3$ is present in an amount of from 5 to 30 percent by weight of the sheath.
9. The extensible nonwoven of claim 1 wherein the fiber is a bicomponent fiber and an inorganic filler is present in an amount of from 2 to 15 percent by weight of the fiber.
10. The extensible nonwoven of claim 1 wherein polydimethylsiloxane is present and has an average particle size when in powder form of between 2 and 5 microns.
11. The extensible nonwoven of claim 1 wherein the fiber is a monocomponent fiber and polydimethylsiloxane is present in an amount of from 0.5 to 1 % by weight of the fiber.

12. The extensible nonwoven of claim 1 wherein the fiber is a bicomponent fiber in the form of sheath/core and polydimethylsiloxane is present in an amount of from 0.5 to 10 by weight of the sheath.

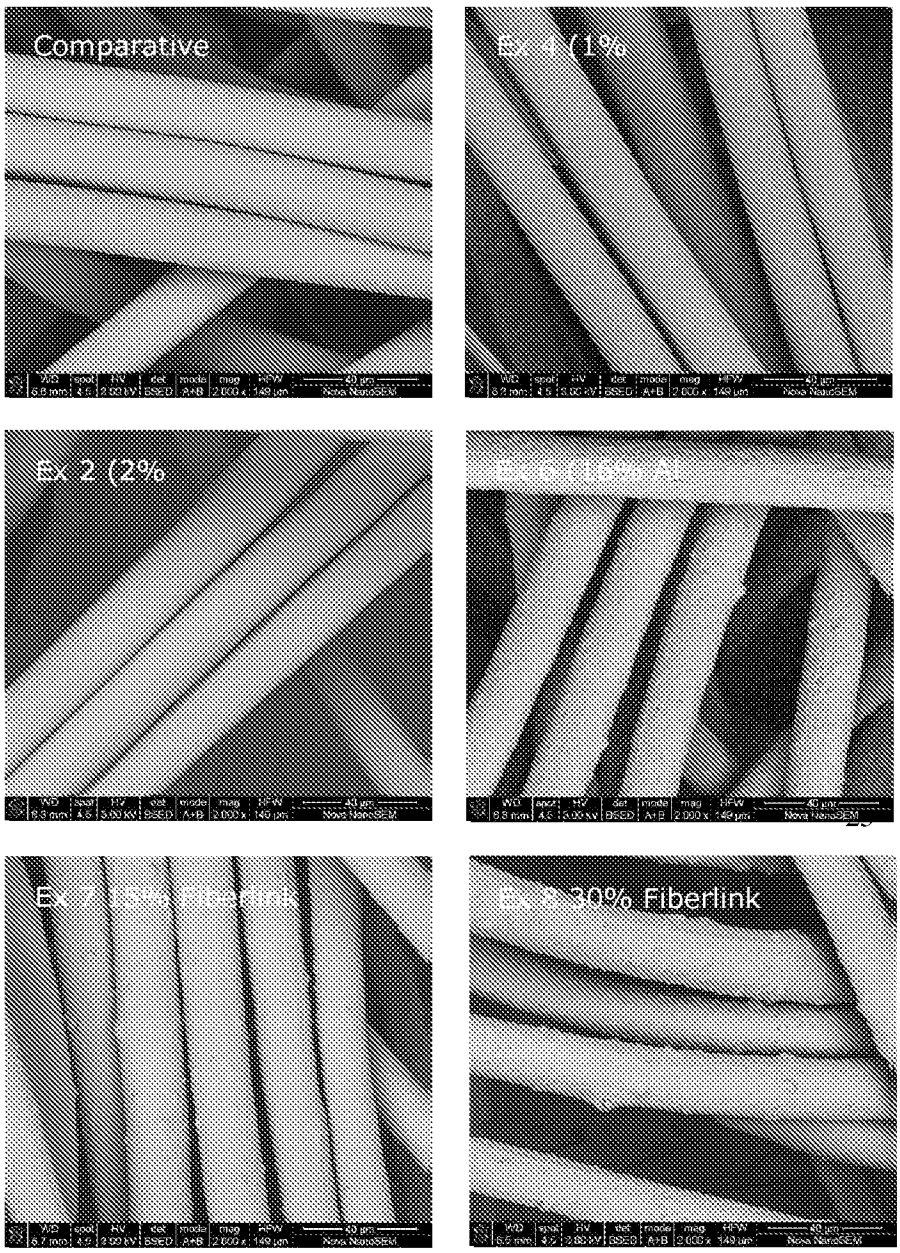
Comparative
Ex 4 (1%
Ex 2 (2%
Ex 5 (1.5% Alt
Ex 7 (1.5% Fiberlink
Ex 8 30% Fiberlink

Figure 1

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/076396

A. CLASSIFICATION OF SUBJECT MATTER
INV. D04H3/007 D04H3/147 D04H3/16 D01F1/10 D01F6/46
D01F8/06 D06M11/76 D06M11/79 D06M15/643 D06M23/08
ADD.
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)
D04H D01F D06M

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)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2007/064728 A1 (DOW GLOBAL TECHNOLOGIES INC [US]; PENG HONG [US]; PEPPER RANDY E [US];) 7 June 2007 (2007-06-07) paragraph [0083]; claims; figures 1-6	1-9
X	US 7 422 712 B2 (DELUCIA MARY L [US] ET AL DELUCIA MARY LUCILLE [US] ET AL) 9 September 2008 (2008-09-09) column 1, lines 22-25 column 3, line 40 - column 7, line 46 column 9, line 43 - page 10, line 54 column 16, lines 59-62 claims 1,9-27	1-6,11
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A	column 8, line 50 - column 9, line 45; examples; tables	10-12

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
12 March 2014	19/03/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Barathe, Rainier

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/076396

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	WO 2009/094321 A1 (IMERYS PIGMENTS INC [US]; MCAMISH LARRY [US]) 30 July 2009 (2009-07-30) the whole document	1-9
A	WO 2004/061171 A2 (KIMBERLY CLARK CO [US]) 22 July 2004 (2004-07-22) the whole document	8-12

INTERNATIONAL SEARCH REPORT

Information on patent family members

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