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(54) Title: POLYOLEFIN BICOMPONENT FIBER WITH COMPATIBILIZER AND POST INDUSTRIAL POLYOLEFIN RESIN

(57) Abstract: The present disclosure provides a fiber. In an embodiment, the fiber includes a first region and a second region. A component is present in at least one of the first region and the second region. The component is composed of (i) a post-industrial resin (PIR) and (ii) an acrylate-based compatibilizer.

POLYOLEFIN BICOMPONENT FIBER WITH COMPATIBILIZER AND POST
INDUSTIRAL POLYOLEFIN RESIN

BACKGROUND

[0001] Bicomponent fibers are fibers composed of two regions and corresponding polymer compositions that are extruded from the same spinneret with both compositions contained within the same filament or fiber. When the fiber leaves the spinneret, it consists of non-mixed components that are in contact at the interface. The two polymer compositions can differ in their chemical and/or physical properties. Or the polymer composition can be same, and, in that case, it is a mono component fiber.

[0002] Spunbond nonwoven fabrics are widely used in various applications, such as hygiene, medical, industrial, or automotive applications to provide low basis weight, economical, strong, and cloth-like fabrics. A common bicomponent configuration for spunbound nonwoven fabric is polyethylene (PE) spun with polypropylene (PP) in a bicomponent fiber configuration with the PP being the core and PE being the sheath for nonwoven web. However, it is a common industrial occurrence that the edges of the nonwoven web (10-15% of the production) need to be trimmed off due to poor fiber laydown quality. The trimmed edges of nonwoven web are usually scrapped. Recycling of the trimmed edges ("regrind") into the spunbond production is desired by the spunbond converters. However, currently only low levels of regrind (typically 3% or less) can be incorporated back into commercial fiber production without sacrificing the spinning process, due to significant fiber breaks. Blending the trimmed edges with virgin olefin-based polymer has seen only limited success in increasing the amount of bicomponent fiber regrind that can be incorporated back into the fiber production process.

[0003] Hence, a need exists for increasing the amount of fiber regrind (and PE/PP fiber regrind in particular) back into a fiber spinning without causing fiber breaks during spinning.

SUMMARY

[0004] The present disclosure provides a fiber. In an embodiment, the fiber includes a first region a second region. A component is present in at least one of the first region and the second region. The component is composed of (i) a post-industrial resin (PIR) and (ii) an acrylate-based compatibilizer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIG. 1 is a schematic representation of a fiber spinning process.

DEFINITIONS

[0006] Any reference to the Periodic Table of Elements is that as published by CRC Press, Inc., 1990–1991. Reference to a group of elements in this table is by the new notation for numbering groups.

[0007] For purposes of United States patent practice, the contents of any referenced patent, patent application or publication are incorporated by reference in their entirety (or its equivalent US version is so incorporated by reference) especially with respect to the disclosure of definitions (to the extent not inconsistent with any definitions specifically provided in this disclosure) and general knowledge in the art.

[0008] The numerical ranges disclosed herein include all values from, and including, the lower and upper value. For ranges containing explicit values (e.g., a range from 1, or 2, or 3 to 5, or 6, or 7), any subrange between any two explicit values is included (e.g., the range 1–7 above includes subranges 1 to 2; 2 to 6; 5 to 7; 3 to 7; 5 to 6; etc.).

[0009] Unless stated to the contrary, implicit from the context, or customary in the art, all parts and percents are based on weight and all test methods are current as of the filing date of this disclosure.

[0010] The terms “comprising”, “including”, “having” and their derivatives do not exclude the presence of any additional component or procedure. The term, “consisting essentially of” excludes any other component or procedure, except those essential to operability. The term “consisting of” excludes any component or procedure not specifically stated.

[0011] The term “denier” is the linear mass density of a fiber. Denier is defined as the grams of the fiber per 9000 meters of the fiber length.

[0012] An “ethylene-based polymer” is a polymer that contains more than 50 weight percent (wt%) polymerized ethylene monomer (based on the total amount of polymerizable monomers) and, optionally, may contain at least one comonomer. Ethylene-based polymer includes ethylene homopolymer, and ethylene copolymer (meaning units derived from ethylene and one or more

comonomers). The terms "ethylene-based polymer" and "polyethylene" may be used interchangeably. Nonlimiting examples of ethylene-based polymer (polyethylene) include low density polyethylene (LDPE) and linear polyethylene. Nonlimiting examples of linear polyethylene include linear low density polyethylene (LLDPE), ultra low density polyethylene (ULDPE), very low density polyethylene (VLDPE), multi-component ethylene-based copolymer (EPE), ethylene/ α -olefin multi-block copolymers (also known as olefin block copolymer (OBC)), substantially linear, or linear, plastomers/elastomers, and high density polyethylene (HDPE). Generally, polyethylene may be produced in gas-phase, fluidized bed reactors, liquid phase slurry process reactors, or liquid phase solution process reactors, using a heterogeneous catalyst system, such as Ziegler-Natta catalyst, a homogeneous catalyst system, comprising Group 4 transition metals and ligand structures such as metallocene, non-metallocene metal-centered, heteroaryl, heterovalent aryloxyether, phosphinimine, and others. Combinations of heterogeneous and/or homogeneous catalysts also may be used in either single reactor or dual reactor configurations.

[0013] High density polyethylene (or "HDPE") is an ethylene homopolymer or an ethylene/ α -olefin copolymer with at least one C_4 – C_{10} α -olefin comonomer, or C_4 – C_8 α -olefin comonomer and a density from 0.940 g/cc, or 0.945 g/cc, or 0.950 g/cc, 0.953 g/cc to 0.955 g/cc, or 0.960 g/cc, or 0.965 g/cc, or 0.970 g/cc, or 0.975 g/cc, or 0.980 g/cc. The HDPE can be a monomodal copolymer or a multimodal copolymer. A "monomodal ethylene copolymer" is an ethylene/ C_4 – C_{10} α -olefin copolymer that has one distinct peak in a gel permeation chromatography (GPC) showing the molecular weight distribution. A "multimodal ethylene copolymer" is an ethylene/ C_4 – C_{10} α -olefin copolymer that has at least two distinct peaks in a GPC showing the molecular weight distribution. Multimodal includes copolymer having two peaks (bimodal) as well as copolymer having more than two peaks. Nonlimiting examples of HDPE include DOW™ High Density Polyethylene (HDPE) Resins (available from The Dow Chemical Company), CONTINUUM™ Bimodal Polyethylene Resins (available from The Dow Chemical Company), LUPOLEN™ (available from LyondellBasell), as well as HDPE products from Borealis, Ineos, and ExxonMobil.

[0014] "Low density polyethylene" (or "LDPE") may also be referred to as "high pressure ethylene polymer" or "highly branched polyethylene" and consists of ethylene homopolymer, or ethylene/ α -olefin copolymer comprising at least one C_3 – C_{10} α -olefin that has a density from 0.915 g/cc to less than 0.940 g/cc and contains long chain branching with broad MWD. LDPE is typically produced by way of high pressure free radical polymerization (tubular reactor or autoclave with free radical initiator). LDPE resins typically have a density in the range of 0.915 to 0.935 g/cc. Nonlimiting examples of LDPE include MarFlex™ (Chevron Phillips), LUPOLEN™ (LyondellBasell), as well as LDPE products from Dow, Borealis, Ineos, ExxonMobil, and others.

[0015] "Linear low density polyethylene" (or "LLDPE") is a linear ethylene/ α -olefin copolymer containing heterogeneous short-chain branching distribution comprising units derived from ethylene and units derived from at least one C_3 – C_{10} α -olefin comonomer. LLDPE is characterized by little, if any, long chain branching, in contrast to conventional LDPE. LLDPE has a density from 0.910 g/cc to less than 0.940 g/cc. Nonlimiting examples of LLDPE include TUFLIN™ linear low density polyethylene resins (available from The Dow Chemical Company), DOWLEX™ polyethylene resins (available from the Dow Chemical Company), FINGERPRINT™ polyethylene resins (available from the Dow Chemical Company), and MARLEX™ polyethylene (available from Chevron Phillips).

[0016] The term "meltblown" refers to the fabrication of nonwoven fabrics via a process which generally includes the following steps: (a) extruding molten thermoplastic strands from a spinneret; (b) simultaneously quenching and attenuating the polymer stream immediately below the spinneret using streams of high velocity heated air; (c) collecting the drawn strands into a web on a collecting surface. Meltblown webs can be bonded by a variety of means including, but not limited to, autogeneous bonding, i.e., self bonding without further treatment, thermo-calendering process, adhesive bonding process, hot air bonding process, needle punch process, hydroentangling process, and combinations thereof.

[0017] The terms "nonwoven," "nonwoven web," and "nonwoven fabric" are used herein interchangeably. "Nonwoven" refers to a web or fabric having a structure of individual fibers or threads which are randomly interlaid, but not in an identifiable manner as is the case for a knitted fabric.

[0018] An "olefin-based polymer" is a polymer that contains a majority mole percent polymerized olefin monomer (based on total amount of polymerizable monomers), and optionally, may contain at least one comonomer. Nonlimiting examples of olefin-based polymers include ethylene-based polymer and propylene-based polymer.

[0019] The term "polymer" is a macromolecular compound prepared by polymerizing monomers of the same or different type. "Polymer" includes homopolymers, copolymers, terpolymers, interpolymers, and so on. The term "interpolymer" means a polymer prepared by the polymerization of at least two types of monomers or comonomers. It includes, but is not limited to, copolymers (which usually refers to polymers prepared from two different types of monomers or comonomers, terpolymers (which usually refers to polymers prepared from three different types of monomers or comonomers), tetrapolymers (which usually refers to polymers prepared from four different types of monomers or comonomers), and the like.

[0020] A "propylene-based polymer" is a polymer that contains a majority amount of polymerized propylene based on the weight of the polymer and, optionally, may comprise at least one comonomer. Propylene-based polymers typically comprise at least 50 mole percent (mol%) units derived from propylene (based on the total amount of polymerizable monomers).

[0021] The term "spunbond" refers to the fabrication of nonwoven fabric including the following steps: (a) extruding molten thermoplastic strands from a plurality of fine capillaries called a spinneret; (b) quenching the strands with a flow of air which is generally cooled in order to hasten the solidification of the molten strands; (c) attenuating the strands by advancing them through the quench zone with a draw tension that can be applied by either pneumatically entraining the strands in an air stream or by winding them around mechanical draw rolls of the type commonly used in the textile fibers industry; (d) collecting the drawn strands into a web on a foraminous surface (e.g., moving screen or porous belt); and (e) bonding the web of loose strands into a nonwoven fabric. Bonding can be achieved by a variety of means including, but not limited to, thermo-calendaring process, adhesive bonding process, hot air bonding process, needle punch process, hydroentangling process, and combinations thereof.

TEST METHODS

[0022] Aspirator drawing. A yarn of 144 filaments is drawn using an air aspirator. The fibers are drawn using a slot pressure that starts with an initial value of 5 or 10 psi, and then is incrementally increased to the maximum slot pressure while maintaining stable fiber spinning. The maximum aspirator pressure at which no fiber breaks are noticed, is reported in psi for specific fiber compositions.

[0023] Density. Density is measured by the displacement (Archimedes) method, ASTM method D792 Method B. A sample is weighed in air (dry weight) and immersed in a fluid (wet weight). Knowing the density of the immersion fluid, the loss in weight of the sample on immersion allows the sample density to be calculated. A sheet of material is molded under per ASTM D4703 per Annex A.1 Procedure C (15°C cooling). On removal from the press, 3 (three) coupons (~1.5" x ~0.5" x ~0.125") are cut from the sheet and density is measured. For Method B, the samples are weighed in air and then immersed in the fluid. The fluid (IPA, isopropyl alcohol) is contained in a double walled vessel and the temperature is controlled to 23°C +/- 0.1°C. The samples are allowed to soak in the fluid for 8 minutes to ensure the samples have equilibrated to the bath temperature. The samples are then weighed while still immersed in the fluid. A glass sinker of known dry weight and volume is then weighed while immersed in the fluid. The density of the immersion fluid is calculated from the known and measured values for the glass sinker (this corrects for any small deviations in the fluid density in the allowable temperature range). The density of the samples may then be calculated from the known fluid density and the measured wet and dry sample weights.

[0024] Differential Scanning Calorimetry (DSC). Differential scanning calorimetry 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).

[0025] DSC analysis is determined using DSC from TA Instruments, Inc (or other suppliers). Calibration of the DSC is done as follows. First, instrument baseline needs to be calibrated using

standard procedure for the DSC. Then about 5-7 milligrams 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 28.57 J/g for the heat of fusion. The polyethylene 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. In reference to ASTM standard D3418, the DSC test is conducted using a heat-cool-heat cycle. First the sample is heated to 230°C at a rate of 10°C/min and held isothermally for 5min. to remove thermal and process history. The sample is then quenched to -40°C at a rate of 10°C/min. and held isothermally once again for 5min. Lastly, the sample is heated at a rate of 10°C/min. to 230°C for the second heating cycle. The resulting enthalpy curves are analyzed for peak melt temperature, onset and peak crystallization temperatures, and the total heat of fusion (also known as heat of melting), ΔH_f . The total heat of fusion, in Joules/gram, was measured by integrating the area under the melting endotherm (second heat) from -20°C to the end of melting by using a linear baseline. Heat of fusion of 100% crystalline polyethylene is taken to be 292 Joules/gram to calculate wt% crystallinity. The DSC tests are performed using the TA Instruments Discovery DSC, and data analyses are conducted via TA Instruments Universal Analysis and TRIOS software packages.

[0026] Fiber Spinning. Fibers are spun on a Hills Bicomponent Continuous Filament Fiber Spinning Line at a throughput rate of 0.6 ghm (grams per hole per minute). A Hills Bicomponent die is used to operate at a 70/30 core/sheath ratio. The die configuration consists of 144 holes, with a hole diameter of 0.6 mm. The hole has a L/D of 4/1. Quench air temperature and flow rate are set at 15-18 °C and 520 cfm (cubic feet per minute), respectively. Extruder profiles are adjusted to achieve a melt temperature of 230 °C for polyethylene sheath and 250 °C for polypropylene sheath; and 250 °C for core material.

[0027] Fiber Tensile Testing: The fiber tensile test is conducted according to ISO 2062. Spun yarns are tested at 23 °C. The tensile properties are determined on a Zwick tensile tester using a

gauge length of 200 mm and a rate of elongation of 200 mm/min. Tenacity is determined at break force.

[0028] Fiber size measurement. Fiber diameter is measured via optical microscopy with an Olympus SZX16 stereomicroscope.

[0029] Melt Index. Melt index (MI) or I2, was measured in accordance with ASTM D 1238-10, Condition 190°C/2.16 kg, Method B, and was reported in grams eluted per 10 minutes.

[0030] Melt Flow Rate. Melt flow rate (MFR) (for propylene-based polymer) was measured in accordance with ASTM D 1238-10, Condition 230°C/2.16 kg, Method B, and was reported in grams eluted per 10 minutes.

[0031] Ramp-to-break (RTB) drawing. RTB represents maximum speed of denier roll in meters per minute. A yarn of 144 filaments is drawn in molten/semi-molten state using denier roll starting with an initial speed of 200 to 500 mpm and incrementally increased until fiber breaks are observed. The maximum denier roll speed is reported as RTB in mpm for specific fiber composition.

DETAILED DESCRIPTION

[0032] The present disclosure provides a fiber. The fiber includes a first region and a second region. The fiber also includes a component present in at least one of the first region and the second region. The component is composed of (i) a post-industrial resin (PIR) and (ii) an acrylate-based compatibilizer.

[0033] A “fiber,” as used herein, is an elongated strand of material in which the length to diameter ratio is greater than 10. A fiber typically has a round, or substantially round, cross section. Other cross-sectional shapes for the fiber include a trilobal shape, or a flat (*i.e.*, “ribbon” like) shape. A fiber excludes a film which has opposing parallel, or substantially parallel, sides.

1. First region

[0034] The fiber includes the first region. The first region is an olefin-based polymer and is selected from a propylene-based polymer, an ethylene-based polymer, and combinations thereof.

[0035] In an embodiment, the first region is a propylene-based polymer. The propylene-based polymer can be a propylene homopolymer, a propylene/ α -olefin interpolymers, or a combination thereof. In a further embodiment, the propylene-based polymer is a propylene homopolymer. The propylene homopolymer has a density from 0.88 g/cc to 0.92 g/cc, or 0.90 g/cc. The propylene homopolymer has a melt flow rate (MFR) from 1.0 g/10 min to 50 g/10 min, or from 10 g/10 min to 40 g/10 min, or from 30 g/10 min to 40 g/10 min.

[0036] In an embodiment, the propylene-based polymer is a propylene/ α -olefin copolymer with a C₂ (ethylene) comonomer or a C₄-C₂₀ α -olefin comonomer, or a C₄-C₈ α -olefin comonomer. The propylene/ α -olefin copolymer has a density from 0.87 g/cc to 0.92 g/cc, or 0.90 g/cc. The propylene/ α -olefin interpolymers has a MFR from 1.0 g/10 min to 50 g/10 min, or from 10 g/10 min to 40 g/10 min, or from 30 g/10 min to 40 g/10 min. Nonlimiting examples of suitable propylene/ α -olefin copolymer include propylene/ethylene copolymer, propylene/1-butene copolymer, propylene/1-hexene copolymer, propylene/4-methyl-1-pentene copolymer, propylene/1-octene copolymer, and combinations thereof.

[0037] In an embodiment, the first region is an ethylene-based polymer. The ethylene-based polymer can be an ethylene homopolymer, an ethylene/C₃-C₁₀ α -olefin copolymer, or an ethylene C₄-C₈ α -olefin copolymer. The ethylene-based polymer has a density from 0.930 g/cc to 0.960 g/cc and a melt index (MI) from 1 g/10 min to 50 g/10 min, or from 10 g/10 min to 40 g/10 min, or from 20 g/10 min to 40 g/10 min. Nonlimiting examples of suitable ethylene-based polymer include ethylene plastomer/elastomer, high density polyethylene (HDPE), linear low density polyethylene (LLDPE), low density polyethylene (LDPE), ethylene/ α -olefin multi-block copolymer, and combinations thereof.

[0038] In an embodiment, the ethylene-based polymer is HDPE, and the HDPE is an ethylene/octene copolymer with one, some, or all of the following properties:

(i) a density from 0.950 g/cc to 0.960 g/cc, or 0.955 g/cc; and/or

(ii) an I₂ from 10 g/10 min to 40 g/10 min, or from 20 g/10 min to 30 g/10 min, or 30 g/10 min.

2. *Second region*

[0039] The present fiber includes the second region. The second region is an olefin-based polymer and is selected from a propylene-based polymer, an ethylene-based polymer, and combinations thereof.

[0040] The olefin-based polymer of the second region can be a propylene-based polymer or an ethylene-based polymer. The propylene-based polymer and the ethylene-based polymer for the second region can be any propylene-based polymer or ethylene-based polymer as for the first region as disclosed above. In an embodiment, when the first region is a propylene-based polymer, the olefin-based polymer for the second region is an ethylene-based polymer. Alternatively, when the first region is an ethylene-based polymer, the olefin-based polymer for the second region is a propylene-based polymer.

3. *Component*

[0041] The fiber includes the component (interchangeably referred to as “recycled component”). The recycled component includes the post-industrial resin. The term “post-industrial resin” (or “PIR”) is a polymeric material that has been recovered from an industrial process and/or a manufacturing process which has subjected the polymeric resin to one or more heating and/or molding processes. PIR is distinct from a post-consumer resin (or “PCR”) as PIR has not yet been in the hands of a consumer. PIR is typically collected from a manufacturing plant or an industrial site and is not collected from a recycling program or a recycling plant. Where PCR typically requires additional cleaning and processing before it can be re-introduced into a manufacturing line, PIR typically does not need additional cleaning and/or processing before it can be re-introduced in a manufacturing line.

[0042] PIR (and PCR) is distinct from virgin polymeric material. Since PIR has gone through an initial heat and molding process; PIR is not “virgin” polymeric material. A “virgin polymeric material” is a polymeric material that has not undergone, or otherwise has not been subject to, one or more heat process(es) and/or one or more molding process(es). The physical, chemical and flow properties PIR resin differ when compared to virgin polymeric resin.

[0043] In an embodiment, the PIR is trim (or regrind) from a bicomponent fiber manufacturing line. The PIR includes from 20 wt% to 60 wt% of an ethylene-based polymer and from 80 wt% to 40 wt% of a propylene-based polymer, based on total weight of the PIR. The

ethylene-based polymer may be any ethylene-based polymer as previously disclosed herein. The propylene-based polymer may be any propylene-based polymer as previously disclosed herein.

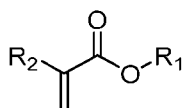
[0044] In an embodiment, the PIR contains

(A) from 20 wt% to 60 wt%, or from 20 wt% to 50 wt%, or from 25 wt% to 35 wt%, or 30 wt% of an ethylene-based polymer having density from 0.930 g/cc to 0.96 g/cc, or from 0.95 g/cc to 0.96 g/cc, and an MI from 10 g/ 10 min to 40 g/10 min, or from 20 g/10 min to 30 g/10 min; and

(B) from 80 wt% to 40 wt%, or from 80 wt% to 50 wt%, or from 75 wt% to 65 wt%, or 70 wt% of a propylene-based polymer that is a propylene homopolymer having a density from 0.89 g/cc to 0.91 g/cc, or 0.9 g/cc and an MFR from 20 g/10 min to 50 g/10 min, or from 30 g/10 min to 40 g/10 min, and weight percent is based on total weight of the PIR, and weight percent is based on total weight of the PIR.

[0045] The recycled component includes the acrylate-based compatibilizer in addition to the PIR. An acrylate-based compatibilizer, as used herein, is polymer that contains an acrylate monomer, the acrylate monomer having the Structure (I) below:

Structure (I)



wherein R₁ is a H or a C₁-C₁₈ alkyl group, or a C₁-C₄ alkyl group and R₂ is H or CH₃.

Non-limiting examples of acrylic comonomers include acrylic acid, methacrylic acid, acrylates, and methacrylates.

[0046] In an embodiment, the acrylate-based compatibilizer is an ethylene/acrylate copolymer with (i) ethylene monomer and (ii) the acrylate monomer as comonomer. The ethylene/acrylate copolymer contains from 5 wt% to 35 wt% acrylate comonomer, based on total weight of the ethylene/acrylate copolymer. Nonlimiting examples of ethylene/acrylate copolymer include ethylene methylacrylate copolymer ("EMA"), ethylene ethylacrylate copolymer ("EEA"), and ethylene butylacrylate copolymer ("EBA"), and combinations thereof.

[0047] In an embodiment, the acrylate-based compatibilizer is EMA, EEA, EBA, or a combination of EMA, EEA, and EEA and EBA.

[0048] The recycled component includes from 99 wt% to 80 wt% of the PIR and from 1 wt% to 20 wt% of the acrylate-based compatibilizer, or from 99 wt% to 90 wt% of the PIR and from 1 wt% to 10 wt% of the acrylate-based compatibilizer, or from 99 wt% to 95 wt% of the PIR and from 1 wt% to 5 wt% of the acrylate-based compatibilizer, and optionally an amount, or greater than 0 wt% to 20 wt%, of virgin polymer based on total weight of the recycled component.

[0049] In an embodiment, the recycled component includes from 99 wt% to 80 wt% of the PIR and from 1 wt% to 20 wt% of the acrylate-based compatibilizer, based on the total weight of the recycled component,

the PIR includes

(A) from 20 wt% to 60 wt%, or from 20 wt % to 50 wt%, or from 25 wt% to 35 wt%, or 30 wt% of an ethylene-based polymer that is an HDPE having density from 0.95 g/cc to 0.96 g/cc and an MI from 10 g/ 10 min to 40 g/10 min, or from 20 g/10 min to 30 g/10 min (based on total weight of the PIR); and

(B) from 80 wt% to 40 wt%, or from 80 wt% to 50 wt%, or from 75 wt% to 65 wt%, or 70 wt% of a propylene-based polymer that is a propylene homopolymer having a density from 0.89 g/cc to 0.91 g/cc, or 0.9 g/cc and an MFR from 20 g/10 min to 50 g/10 min, or from 30 g/10 min to 40 g/10 min (based on total weight of the PIR); and

the acrylate-based compatibilizer is

an ethylene/acrylate copolymer selected from EMA, EEA, and EBA, and any combination thereof.

[0050] The fiber may further include additional optional components such as one or more additives. Such additives include, but are not limited to, antistatic agents, color enhancers, dyes, lubricants, fillers, pigments, primary antioxidants, secondary antioxidants, processing aids, UV stabilizers, anti-blocks, slip agents, tackifiers, fire retardants, anti-microbial agents, odor reducer agents, anti-fungal agents, and combinations thereof. The additive(s) may be present in the fiber in an amount from 0 wt%, or from 0.1 wt% to 10 wt%, or from 0.1 wt% to 5 wt%, or from 0.1 wt% to 1.0 wt%, based on total weight of the fiber.

4. *Fiber*

[0051] The present fiber is a bicomponent fiber. A "bicomponent fiber" (or "BICO fiber" or "BICO") is a fiber that has two or more, or two, distinct polymer regions or domains. Bicomponent fibers are also known as conjugated fibers or multicomponent fibers. The polymers are usually different from each other although two or more regions may contain the same polymer. The polymers are arranged in substantially distinct regions, or zones, across the cross-section of the bicomponent fiber, and usually extend continuously along the length of the bicomponent fiber. The configuration of a bicomponent fiber can be, for example, a sheath/core arrangement (in which one polymer (the "core") is surrounded by another polymer (the "sheath")), a side by side arrangement, a pie arrangement or an "islands-in-the-sea" arrangement.

[0052] In an embodiment, the fiber is a bicomponent fiber with a sheath/core configuration. The sheath is from 20 wt% to 60 wt%, or from 20 wt% to 50 wt%, or from 20 wt% to 40 wt%, or 30 wt% of the fiber and the core is from 80 wt% to 40 wt%, or from 80 wt% to 50 wt%, or from 80 wt% to 60 wt%, or 70 wt% of the fiber (based on total weight of the fiber). The fiber includes

- (1) a first region that is the sheath and is a propylene-based polymer;
- (2) a second region that is the core, the core composed of
 - (A) from 65 wt% to 98wt%, or 67 wt% of a propylene-based polymer (based on total weight of the core), and
 - (B) from 35 wt% to 2 wt%, or from 33 wt% to 2wt%, or from 20% to 2%, or 33 wt% of the recycled component (based on total weight of fiber), the recycled component is from 99 wt% to 80 wt% of the PIR and from 1 wt% to 20 wt% of the acrylate-based compatibilizer (based on total weight of the recycled component),
the PIR includes
 - (i) from 20 wt% to 60 wt%, or from 20 wt% to 50 wt%, or from 25 wt% to 35 wt%, or 30 wt% of an ethylene-based polymer having density from 0.930 g/cc to 0.96 g/cc, or from 0.95 g/cc to 0.96 g/cc and an MI from 10 g/ 10 min to 40 g/10 min, or from 20 g/10 min to 30 g/10 min (based on total weight of the PIR); and
 - (ii) from 80 wt% to 40 wt%, or from 80 wt% to 50 wt%, or from 75 wt% to 65 wt%, or 70 wt% of a propylene-based polymer that is a propylene homopolymer having a density

from 0.89 g/cc to 0.91 g/cc, or 0.9 g/cc and an MFR from 20 g/10 min to 50 g/10 min, or from 30 g/10 min to 40 g/10 min (based on total weight of the PIR); and the acrylate-based compatibilizer is an ethylene/acrylate copolymer selected from EMA, EEA, and EBA, and any combination thereof.

[0053] In an embodiment, the fiber is a bicomponent fiber with a sheath/core configuration. The sheath is from 20 wt% to 60 wt%, or from 20 wt% to 50 wt%, or from 20 wt% to 40 wt%, or 30 wt% of the fiber and the core is from 80 wt% to 40 wt%, or from 80 wt% to 50 wt%, or from 80 wt% to 60 wt%, or 70 wt% of the fiber (based on total weight of the fiber). The fiber includes

(1) a first region that is the sheath and is an ethylene-based polymer;
(2) a second region that is the core, the core composed of
(A) from 65 wt% to 98 wt%, or 67 wt% of a propylene-based polymer (based on total weight of the core), and
(B) from 35 wt% to 2 wt%, or from 33 wt% to 2 wt%, or from 20 wt% to 2 wt%, or 33 wt% of the recycled component (based on total weight of the core), the recycled component is from 99 wt% to 85 wt% of the PIR and from 1 wt% to 15 wt% of the acrylate-based compatibilizer (based on total weight of the recycled component),
the PIR includes

(i) from 20 wt% to 60 wt%, or from 20 wt% to 50 wt%, or from 25 wt% to 35 wt%, or 30 wt% of an ethylene-based polymer having density from 0.930 g/cc to 0.96 g/cc, or from 0.95 g/cc to 0.96 g/cc and an MI from 10 g/ 10 min to 40 g/10 min, or from 20 g/10 min to 30 g/10 min (based on total weight of the PIR); and
(ii) from 80 wt% to 40 wt%, or from 80 wt% to 50 wt%, or from 75 wt% to 65 wt%, or 70 wt% of a propylene-based polymer that is a propylene homopolymer having a density from 0.89 g/cc to 0.91 g/cc, or 0.9 g/cc and an MFR from 20 g/10 min to 50 g/10 min, or from 30 g/10 min to 40 g/10 min (based on total weight of the PIR); and
the acrylate-based compatibilizer is an ethylene/acrylate copolymer selected from EMA, EEA, and EBA, and any combination thereof.

[0054] In an embodiment, the fiber is a bicomponent fiber with a sheath/core configuration. The sheath is from 20 wt% to 60 wt%, or from 20 wt% to 50 wt%, or from 20 wt% to 40 wt%, or or 30 wt% of the fiber and the core is from 80 wt% to 40 wt%, or from 80 wt% to 50 wt%, or from 80 wt% to 60 wt%, or 70 wt% of the fiber (based on total weight of the fiber). The fiber includes

(1) a first region that is the sheath, the sheath composed of

(A) from 65 wt% to 98 wt%, or 83 wt% of an ethylene-based polymer (based on total weight of the sheath), and

(B) from 35 wt% to 2 wt%, or from 33 wt% to 2 wt%, or from 20 wt% to 2 wt%, or 17 wt% of the recycled component (based on total weight of the sheath), the recycled component is from 99 wt% to 85 wt% of the PIR and from 1 wt% to 15 wt% of the acrylate-based compatibilizer (based on total weight of the recycled component),

the PIR includes

(i) from 20 wt% to 60 wt%, or from 20 wt% to 50 wt%, or from 25 wt% to 35 wt%, or 30 wt% of an ethylene-based polymer having density from 0.930 g/cc to 0.960 g/cc, or from 0.95 g/cc to 0.96 g/cc and an MI from 10 g/ 10 min to 40 g/10 min, or from 20 g/10 min to 30 g/10 min (based on total weight of the PIR); and

(ii) from 80 wt% to 40 wt%, or from 80 wt% to 50 wt%, or from 75 wt% to 65 wt%, or 70 wt% of a propylene-based polymer that is a propylene homopolymer having a density from 0.89 g/cc to 0.91 g/cc, or 0.9 g/cc and an MFR from 20 g/10 min to 50 g/10 min, or from 30 g/10 min to 40 g/10 min (based on total weight of the PIR); and

the acrylate-based compatibilizer is

an ethylene/acrylate copolymer selected from EMA, EEA, and EBA, and any combination thereof; and

(2) a second region that is the core, the core composed of a propylene-based polymer.

[0055] The fiber may be a melt-spun fiber or a meltblown fiber. In an embodiment, the fiber is a melt-spun fiber. A “melt-spun fiber,” as used herein, is a fiber produced by a melt-spinning process. Melt-spinning is a process whereby a polymer melt is extruded through a plurality of fine die capillaries (such as a spinneret, for example) as molten filaments while simultaneously applying an extensional force which reduces the density of the molten filaments. The molten

filaments solidify upon cooling below their melt temperature to form fibers. The term “melt spinning” encompasses stable fiber spinning (including short spinning and long spinning) and bulk continuous filament fiber. Melt spun fibers may be cold-drawn.

[0056] In an embodiment, the fiber is a meltblown fiber. A “meltblown fiber” is a fiber formed by extruding a molten thermoplastic polymer composition through a plurality of fine, usually circular, die capillaries as molten threads or filaments into converging high velocity gas streams (e.g. air) which function to attenuate the threads or filaments to reduced density. The filaments or threads are carried by the high velocity gas streams and deposited on a collecting surface to form a web of randomly dispersed fibers with average density generally smaller than 10 microns.

[0057] In an embodiment, the fiber has a density from 1 denier to 10 denier, or from 1 denier to 5 denier, or from 1 denier to 3 denier, or from 1 denier to 2 denier.

[0058] In an embodiment, the fiber has a density from 1 denier to 2 denier and a ramp-to-break from 1000 meters per minute (mpm) to 5000 mpm, or from 2000 mpm to 5000 mpm.

[0059] In an embodiment, the fiber contains from 2 wt% to 35 wt%, or from 10 wt% to 33 wt% of the recycled component based on total weight of the fiber.

[0060] In an embodiment, the first region and the second region are composed of the same polymer. The first region may be composed of a propylene-based polymer and the second region is composed of the same propylene-based polymer present in the first region. Alternatively, the first region may be composed of an ethylene-based polymer and the second region is composed of the same ethylene-based polymer present in the first region.

[0061] The present fiber may comprise two or more embodiments disclosed herein.

5. *Fabrics*

[0062] The present fiber can be used to make fabric spunbond nonwoven fabrics, bonded carded webs, woven fabrics, knitted fabrics, woven tapes, and artificial turf.

[0063] In an embodiment, the present fiber is used to make a non-woven fabric. As used herein a “non-woven” or a “non-woven fabric” or “non-woven material” is an assembly of fibers (for example, core/sheath, islands in the sea, side by side, segmented pie etc.) held together in a

random web such as by mechanical interlocking or by fusing at least a portion of the fibers. The non-woven fabrics according to the present disclosure may be fabricated via different techniques. Such methods include, but are not limited to, spunbond process, carded web process, air laid process, thermo-calendaring process, adhesive bonding process, hot air bonding process, needle punch process, hydroentangling process, electrospinning process, and combinations thereof.

[0064] In an embodiment, the present fiber is produced by way of a spunbond process. In a spunbond process, the fabrication of non-woven fabric includes the following steps: (a) extruding strands of the BICO fiber from a spinneret; (b) quenching the strands of the blend with a flow of air which is generally cooled in order to hasten the solidification of the molten strands of the blend; (c) attenuating the filaments by advancing them through the quench zone with a draw tension that can be applied by either pneumatically entraining the filaments in an air stream or by winding them around mechanical draw rolls of the type commonly used in the textile fibers industry; (d) collecting the drawn strands into a web on a foraminous surface, e.g. moving screen or porous belt; and (e) bonding the web of loose strands into the non-woven fabric. Bonding can be achieved by a variety of means including, but not limited to, thermo-calendaring process, adhesive bonding process, hot air bonding process, needle punch process, hydroentangling process, and combinations thereof.

[0065] In the case of the staple or binder fibers, the fibers can be mixed with a variety of other fibers including synthetic fibers such as polyethylene (PE), polypropylene (PP), polyethylene terephthalate (PET), or natural fibers such as cellulose, rayon, or cotton. These fibers can be wet laid, air laid or carded into a non-woven web. The non-woven web can then be laminated to other materials.

[0066] The spunbond non-woven fabric can be used in various end-use applications including, but not limited to, hygiene absorbent products such as diapers, feminine hygiene articles, adult incontinence products, wipes, bandages and wound dressings, and disposable slippers and footwear, medical application such as isolation gowns, surgical gowns, surgical drapes and covers, surgical scrub suits, caps, masks, and medical packaging.

[0067] In an embodiment, the present fiber can be used with a carding line to produce fabric.

[0068] In an embodiment, the present fiber can be used to make carpeting, woven textiles, artificial turf, or other fiber-containing articles.

[0069] By way of example, and not limitation, examples of the present disclosure will now be described in detail in the following examples.

EXAMPLES

1. Materials

[0070] Materials for the inventive examples (“IE”) and comparative samples (“CS”) are listed in Tables 1A and 1B below.

[0071] Table 1A

	Designation	Density (g/cc)	I ₂ (dg/min)	Source
PP 3155	Propylene homopolymer (hPP)	0.9	36*	ExxonMobil
ASPUN 6850A	HDPE1	0.955	30	Dow Chemical Company

*MFR (230°C/2.16Kg), not I₂

[0072] Table 1B below provides properties for Elvaloy acrylate-based compatibilizers (EAC), where “E/MA” is ethylene methacrylate, “E/EA” is ethylene ethylacrylate, and “E/BA” is ethylene butylacrylate.

[0073] Table 1B – compatibilizers (acrylate copolymers) Elvaloy grades (from Dow Chemical)

Grade	Comonomer Type	Acrylate (wt%)*	MI (dg/min)	Density (g/cc)
EAC1	E/MA	20	8	0.942
EAC2	E/MA	24	2	0.944
EAC3	E/MA	24	20	0.944
EAC4	E/MA	24	50	0.944
EAC5	E/MA	9	6	0.93
EAC6	E/EA	18	6	0.93
EAC7	E/EA	34	25	0.93
EAC8	E/BA	27	4	0.926
EAC9	E/BA	35	40	0.93

*wt% based on total weight of the acrylate copolymer

2. Preparation of recycled component (and comparative recycled component)

[0074] Recycled component (Table 2B below) and comparative recycled component (Table 2C) below were made by melt blending and extruding (i) PP3155 (hPP) and ASPUN 6850A (HDPE) (replicating PIR) with (ii) acrylate-based compatibilizer (or polyolefin for comparative recycled

component) on a ZSK-26 twin screw extruder. The melt blending on the ZSK-26 twin screw extruder replicates at least one thermal history for regrind (or trim) generated on a commercial bicomponent fiber production line.

[0075] The melt blending and extrusion conditions for the preparation of the recycled component/comparative recycled component are provided in Table 2A below. In Table 2B (recycled component) and Table 2C (comparative recycled component), the weight percent for each individual material is shown in closed parentheses, wherein weight percent is based on the total weight of the recycled component or comparative recycled component.

[0076] Table 2A—extrusion conditions

ZSK-26 extruder	<i>Machine Set Points</i>
Zone 2 °C	130
Zone 3 °C	180
Zone 4 °C	180
Zone 5 °C	180
Zone 6 °C	180
Zone 7 °C	180
Zone 8 °C	180
Zone 9 °C	180
Zone 10 °C	180
Zone 11 °C	180
Die Zone °C	180
Extruder RPM	300
Main Drive Torque (%)	58
Power Consumption (kw)	3
Bath Temp. (°C)	13
Feeder (poly blend lb/hr.)	25
Total lb/hr. rate	25

[0077] Table 2B—component (PIR + acrylate-based polymer)

Sample Description	Density	MI	1st Cool Tc1 (°C)	2nd Heat Delta H melt (J/g)	2nd Heat Tm1 (°C)	2nd Heat Tm2 (°C)
PP 3155 (68.25)/Aspun 6850A (29.25)/ EAC1 (2.5)	0.9228	19.35	114.5	141.0	162.2	129.5
PP 3155 (66.5)/Aspun 6850A (28.5)/ EAC1 (5)	0.9175	19.19	114.7	141.2	162.3	129.4
PP 3155 (63)/Aspun 6850A (27)/ EAC1 (10)	0.9223	18.64	113.5	132.5	161.7	129.0
PP 3155 (66.5)/Aspun 6850A (28.5)/ EAC2 (5)	0.9217	17.99	114.3	138.1	163.5	129.9
PP 3155 (66.5)/Aspun 6850A (28.5)/ EAC3 (5)	0.9239	20.41	114.4	139.1	162.4	129.4
PP 3155 (66.5)/Aspun 6850A (28.5)/ EAC4 (5)	0.9239	21.13	113.9	141.6	162.7	129.5
PP 3155 (66.5)/Aspun 6850A (28.5)/ EAC5 (5)	0.9215	17.72	114.1	146.8	161.9	129.0
PP 3155 (66.5)/Aspun 6850A (28.5)/ EAC6 (5)	0.9216	18.67	114.3	143.3	161.4	129.0
PP 3155 (66.5)/Aspun 6850A (28.5)/ EAC7 (5)	0.9217	20.02	114.1	140.3	161.7	129.3
PP 3155 (66.5)/Aspun 6850A (28.5)/ EAC8 (5)	0.9174	18.04	114.2	141.1	162.6	129.4
PP 3155 (66.5)/Aspun 6850A (28.5)/ EAC9 (5)	0.9217	19.73	113.4	136.3	162.3	129.1
PP 3155 (70)/Aspun 6850A (30)	0.9223	19.04	115.23	146.9	163.36	130.03

3. Preparation of bicomponent fiber

[0078] A Fiber Hills line was used to produce BICO fibers. All fibers had a sheath/core configuration, with 30 wt% is sheath, and 70 wt% is core, and wt% is based on total weight of the fiber. Three different types of bicomponent fibers were prepared as shown in Table A.

Table A	
BICO1	Sheath: 30 wt% Aspun 6850A Core: 70 wt% (67% PP 3155 + 33 wt% recycled component)
BICO2	Sheath: 30wt% (Aspun 6850A (83%) + 17% recycled component) Core 70 wt% PP3155
BICO3	Sheath: 30wt% (ASPUN 6850A) Core 70wt% (PP 3155 (83%) + 17% recycled component)

[0079] The production conditions for the Fiber Hills line are provided in Table 3 below.

[0080] Table 3—BICO fiber production conditions (Fiber Hills line)

Hole size, mm	0.6
# Of holes	144
GHM	0.6
Quench%	50% or 0%
Quench air temp (deg C)	18
Fiber structure	Sheath/Core
Sheath/Core ratio	30/70
Melt temp, Sheath	230°C
Melt temp, Core	250°C

[0081] Spinnability was tested on Fiber Hills line, by measuring highest air jet pressure with no fiber breaks, for at least 5 minutes or lowest air jet pressure with fiber breaks (depicted in Figure 1). Spinnability was also tested by Ramp to Break (RTB) method. Start of fiber break RTB was recorded.

[0082] BICO fiber properties, Max aspirator pressure and RTB values are provided in Tables 4, 5, 6 and 7 below.

[0083] Table 4: BICO Fiber – Sheath 30% (HDPE1)/Core 70% (hPP (67%) + recycled component (33%)) based on total weight of the fiber; Max aspirator data with different acrylate based compatibilizers.

Table 4

Samples	Fiber Core Composition	Quench	No fiber break Slot Pressure, psi
IE 1	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC1 (5%)] 33%	50%	30
IE 2	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC8 (5%)] 33%	50%	30
IE 12	PP 3155 (83%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC1 (5%)] 17%	50%	55*
CS 1	PP 3155 (100%)	50%	55*
CS 2	PP 3155 (67%) + [PP 3155 (70%)/Aspun 6850A (30%)] (33%)	50%	5
CS 3	PP 3155 (83%) + [PP 3155 (70%)/Aspun 6850A (30%)] (17%)	50%	45

*55 psi Capability upper limit

[0084] Table 5 (below): BICO Fiber – Sheath 30% (HDPE1)/ Core 70% (hPP (67%) + recycled component (33%)) based on total weight of the fiber; RTB data with different acrylate compatibilizers.

Table 5

Sample	Fiber Core Composition	Quench %	RTB, Start of fiber break, m/min
CS 1	PP 3155 (100%)	50%	>5500
CS 1-a	PP 3155 (100%)	0%	>5500
CS 2	PP 3155 (67%) + [PP 3155 (70%)/Aspun 6850A (30%)] (33%)	50%	1000
IE 1	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC1 (5%)] (33 wt%)	50%	3500
IE 10	PP 3155 (67%) + [PP 3155 (68.25%)/Aspun 6850A (29.25%)/ EAC1 (2.5%)] (33 wt%)	50%	3250
IE 10	PP 3155 (67%) + [PP 3155 (68.25%)/Aspun 6850A (29.25%)/ EAC1 (2.5%)] (33 wt%)	0%	4000
IE 11	PP 3155 (67%) + [PP 3155 (63%)/Aspun 6850A (27%)/ EAC1 (10%)] (33wt%)	50%	4000
IE 11	PP 3155 (67%) + [PP 3155 (63%)/Aspun 6850A (27%)/ EAC1 (10%)] (33wt%)	0%	5000
IE 2	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC8 (5%)] (33wt%)	50%	4000
IE 2-a	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC8 (5%)] (33wt%)	0%	4000
IE 3	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC2 (5%)] (33 wt%)	50%	3000
IE 4	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC3 (5%)] (33 wt%)	0%	3500
IE5	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC4 (5%)] (33 wt%)	50%	3000
IE 5-a	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC4 (5%)] (33 wt%)	0%	3500
IE 6	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC5 (5%)] (33wt%)	0%	3000
IE 7	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC6 (5%)] (33wt%)	50%	3000
IE 7	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC6 (5%)] (33wt%)	0%	3000
IE 8	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC7 (5%)] (33wt%)	50%	3000
IE 8	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC7 (5%)] (33 wt%)	0%	3500
IE 9	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC9 (5%)] (33 wt%)	50%	3500

[0085] Table 6: BICO Fiber – Sheath 30% (HDPE1)/ Core 70% (hPP (67%) + recycled component (33%)) based on total weight of the fiber; Fiber strength data, with different acrylate compatibilizers in core.

Table 6

Sample	Fiber Core Composition	Aspirator pressure, psi	Quench	Fiber size, microns	Tenacity at Maximum Force, mean, cN/dtex
CS 1	PP 3155 (100%)	35	50%	19.85	1.31
CS 2	PP 3155 (67%) + [PP 3155 (70%)/Aspun 6850A (30%)] (33%)	35	50%	23.82	0.82
IE 1	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC1 (5%)] (33 wt%)	35	50%	22.22	0.57
IE 10	PP 3155 (67%) + [PP 3155 (68.25%)/Aspun 6850A (29.25%)/ EAC1 (2.5%)] (33%)	35	50%	21.48	1.17
IE 11	PP 3155 (67%) + [PP 3155 (63%)/Aspun 6850A (27%)/ EAC10 (10%)] (33wt%)	35	50%	23.43	0.93
IE 2	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC8 (5%)] (33%)	35	50%	22.53	1.22
IE 3	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC2 (5%)] (33 wt%)	35	50%	27.41	0.93
IE 5	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC4 (5%)] (33 wt%)	35	50%	24.04	0.68
IE 6	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC5 (5%)] (33wt%)	35	50%	23.62	0.90
IE 7	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC6 (5%)] (33%)	35	50%	17.33	1.26
IE 8	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC7 (5%)] (33%)	35	50%	24.19	0.90
IE 9	PP 3155 (67%) + [PP 3155 (66.5%)/Aspun 6850A (28.5%)/ EAC9 (5%)] (33%)	35	50%	22.34	1.29

[0086] Table 7: BICO fiber – Sheath-30% (HDPE1 (83%) + recycled component (17%))/Core-70% (PP3155) Based on total weight of the fiber.

Table 7

Sample	Bico fiber structure	Sheath Composition	Quench %	Fiber size, microns	Fiber size Std Dev	RTB, Start of fiber break, m/min
CS10	Sheath (30%)/Core (70%) PP 3155	Aspun 6850A (83%) + [PP 3155 (70%)/Aspun 6850A (30%)] (17%)	50%	22.15	1.8	2500-3000
IE12	Sheath (30%)/Core (70%) PP 3155	Aspun 6850A(83%) + [PP 3155 (63%)/Aspun 6850A (27%)/ EAC1 (10%)](17%)	50%	22.62	2.55	3500

[0087] Applicant discovered improved spinnability for fibers containing the component by adding acrylate based compatibilizer with recycled component. Bounded by no particular theory, it is believed that incorporation of acrylate-based compatibilizer with PIR, improves themelt property by improving drawability of fibers and lowers peak crystallization temperature that broadens spinning temperature window and allows spinning without causing fiber breaks.

[0088] It is specifically intended that the present disclosure not be limited to the embodiments and illustrations contained herein, but include modified forms of those embodiments including portions of the embodiments and combinations of elements of different embodiments as come within the scope of the following claims.

CLAIMS

1. A fiber comprising:
 - a first region;
 - a second region; and
 - a component present in at least one of the first region and the second region, the component comprising (i) a post-industrial resin (PIR) and (ii) an acrylate-based compatibilizer.
2. The fiber of claim 1 wherein the first region is a polymer selected from the group consisting of a propylene-based polymer, an ethylene-based polymer, and combinations thereof.
3. The fiber of any of claims 1-2 wherein the second region is a polymer selected from the group consisting of a propylene-based polymer, an ethylene-based polymer, and combinations thereof.
4. The fiber of any of claims 1-3 wherein the PIR comprises from 20 wt% to 60 wt% of an ethylene-based polymer and from 80 wt% to 40 wt% of a propylene-based polymer, based on total weight of the PIR.
5. The fiber of any of claims 1-4 wherein the acrylate-based compatibilizer is selected from the group consisting of ethylene methacrylate copolymer, ethylene ethylacrylate copolymer, ethylene butylacrylate copolymer, and combinations thereof.
6. The fiber of any of claims 1-5 wherein the component comprises from 99 wt% to 80 wt% of the PIR and from 1 wt% to 20 wt% of the acrylate-based compatibilizer, based on total weight of the component.

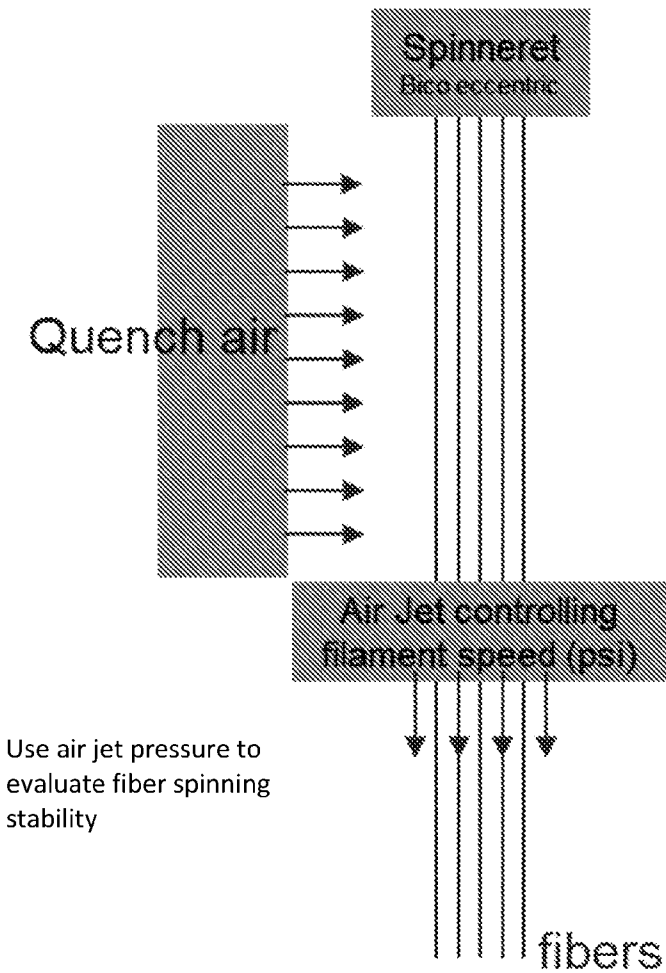
7. The fiber of any of claims 1-6 wherein the first region and the second region are arranged in a configuration selected from the group consisting of a core-sheath configuration, a side-by-side configuration, and an island-in-the-sea configuration.
8. The fiber of claim 7 wherein the first region and the second region are arranged in the core-sheath configuration;
 - the first region is the sheath and is composed of a propylene-based polymer; and
 - the second region is the core and is composed of
 - (A) a propylene-based polymer; and
 - (B) the component.
9. The fiber of claim 7 wherein the first region and the second region are arranged in the core-sheath configuration;
 - the first region is the sheath and is composed of an ethylene-based polymer; and
 - the second region is the core and is composed of
 - (A) a propylene-based polymer; and
 - (B) the component.
10. The fiber of claim 7 wherein the first region and the second region are arranged in the core-sheath configuration;
 - the first region is the sheath composed of
 - (A) an ethylene-based polymer, and
 - (B) the recycled component; and
 - the second region is composed of a propylene-based polymer.
11. The fiber of any of claims 1-10 having a density from 1 denier to 10 denier.
12. The fiber of any of claims 1-11 wherein the fiber comprises from 2 wt% to 35 wt% of the component based on total weight of the fiber.

13. The fiber of claim 7 wherein the first region and the second region are composed of the same polymer.

14. The fiber of claim 13 wherein the first region is composed of a propylene-based polymer;
and
the second region is composed of the same propylene-based polymer present in the first region.

15. The fiber of claim 13 wherein the first region is composed of an ethylene-based polymer;
and
the second region is composed of the same ethylene-based polymer present in the first region.

FIG. 1



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2024/031933

A. CLASSIFICATION OF SUBJECT MATTER INV. D01F1/02 D01F8/06 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) D01F 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		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
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Y	US 2001/014395 A1 (MLEZIVA MARK M [US] ET AL) 16 August 2001 (2001-08-16) paragraphs [0001], [0022], [0057]; figures 1,2A-2B; examples 1-2 -----	1 - 15
Y	EP 1 828 449 B1 (DESSEAUX H TAPIJT FAB [NL]) 13 February 2013 (2013-02-13) paragraphs [0001], [0018]; claim 1 -----	1 - 15
Y	KR 2012 0033771 A (KOLON INC [KR]) 9 April 2012 (2012-04-09) paragraphs [0001], [0025]; claims 1,6; example 1 -----	1 - 15
Y	JP H04 209824 A (DAIWABO CREATE KK) 31 July 1992 (1992-07-31) paragraph [0001]; claims 1,3; examples 1-7 ----- - / - -	1 - 15
☒ 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 "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 17 September 2024		Date of mailing of the international search report 30/10/2024
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Menard, Claire

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International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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