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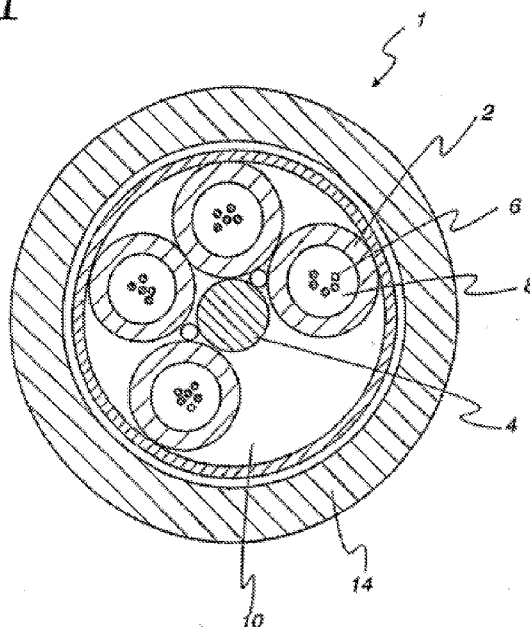
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(54) Title: FLOODING COMPOSITION WITH POLYSILOXANE

Fig. 1



(57) Abstract: The present disclosure provides a flooding composition. In an embodiment, the flooding composition includes in weight percent (wt%) based on the weight of the composition (A) from 20 wt% to 40 wt% of a polyolefin component comprising (i) a first amorphous polyolefin (APO), and (ii) a second APO different than the first APO. The flooding composition also includes (B) from 30 wt% to 60 wt% of a bio-based oil; and (C) from 15 wt% to 45 wt% of a polysiloxane.

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FLOODING COMPOSITION WITH POLYSILOXANE

BACKGROUND

[0001] Flooding compositions are materials designed to occupy void spaces in telecommunication cables, such as the void spaces typically found around and between buffer tubes commonly used in fiber optic cables. Additionally, flooding compositions can be used as filling materials to suspend and protect optical fibers inside buffer tubes. Flooding compositions are free-flowing at elevated temperatures (such as those temperatures used when filling a telecommunication cable), and readily gel at lower temperatures to avoid dripping at room temperature. Additionally, easy-to-clean and non-messy flooding compositions are desirable for ease of installation and prevention of environmental contamination. Although advances have been made in the art of flooding compounds, improvements are still desired.

[0002] Another important property of a flooding composition is its compatibility with polymer materials used in cable constructions such as polyolefin, *i.e.*, low gel pickup for good property retention and cable longevity. Current commercial flooding compounds are based on synthetic hydrocarbons; they are messy, grease/wax-like materials that stick to surfaces that come in contact with them. In case of a spill, they are not environmentally friendly. The wire and cable industry has a continuing interest in flooding compositions that exhibit reduced stickiness, reduced absorption into materials used in the manufacture of cable components such as buffer tubes, jackets, etc., and more environmental friendly.

SUMMARY

[0003] The present disclosure provides a flooding composition. In an embodiment, the flooding composition includes in weight percent (wt%) based on the weight of the composition (A) from 20 wt% to 40 wt% of a polyolefin component comprising (i) a first amorphous polyolefin (APO), and (ii) a second APO different than the first APO. The flooding composition also includes (B) from 30 wt% to 60 wt% of a bio-based oil; and (C) from 15 wt% to 45 wt% of a polysiloxane.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Figure 1 is a cross-sectional view of a loose buffer tube fiber optic cable.

DEFINITIONS

[0005] 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 U.S. 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.

[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] 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.

[0008] The numerical ranges in this disclosure include all values from, and including, the lower and upper value. For ranges containing explicit values (e.g., 1 or 2, or 3 to 5, or 6, or 7), any subrange between any two explicit values is included (e.g., 1 to 2; 2 to 6; 5 to 7; 3 to 7; 5 to 6; etc.).

[0009] "Bio-based fluid" and like terms is a fluid derived from a biological source, such as a plant, animal, bacteria, yeast, algae, and the like. Bio-based fluids can include a single bio-based fluid, *i.e.*, a fluid derived from a single biological source, or a blend of two or more bio-based fluids, *i.e.*, a fluid derived from two or more biological sources. Bio-based fluids are liquid under ambient conditions (23°C and atmospheric pressure), or have a wax-like consistency under ambient conditions (23°C and atmospheric pressure) and become liquid upon heating.

[0010] "Cable," and "power cable" and like terms refer to at least one wire or optical fiber within a sheath, e.g., an insulation covering or a protective outer jacket. Typically, a cable is two or more wires or optical fibers bound together, typically in a common insulation covering and/or a protective jacket. The individual wires or fibers inside the sheath may be

bare, covered or insulated. Combination cables may contain both electrical wires and optical fibers. The cable can be designed for low, medium, and/or high voltage applications. Typical cable designs are illustrated in USP 5,246,783; 6,496,629 and 6,714,707.

[0011] "Composition" and like terms is a mixture or blend of two or more components.

[0012] The terms "comprising," "including," "having," and their derivatives, are not intended to exclude the presence of any additional component, step or procedure, whether or not the same is specifically disclosed. In order to avoid any doubt, all compositions claimed through use of the term "comprising" may include any additional additive, adjuvant, or compound, whether polymeric or otherwise, unless stated to the contrary. In contrast, the term, "consisting essentially of" excludes from the scope of any succeeding recitation any other component, step, or procedure, excepting those that are not essential to operability. The term "consisting of" excludes any component, step, or procedure not specifically delineated or listed. The term "or," unless stated otherwise, refers to the listed members individually as well as in any combination. Use of the singular includes use of the plural and vice versa.

[0013] "Ethylene-based polymer," "polyethylene" and like terms refer to a polymer containing units derived from ethylene. Ethylene-based polymer contains more than 50 mole percent (mol%) units derived from ethylene.

[0014] An "olefin-based polymer," or "polyolefin" 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.

[0015] A "propylene-based polymer" is a polymer that contains more than 50 mole percent polymerized propylene monomer (based on the total amount of polymerizable monomers) and, optionally, may contain at least one comonomer.

[0016] "Residue," when referring to a monomer, refers to that portion of a monomer molecule which resides in a polymer molecule as a result of being polymerized with another monomer or comonomer molecule to make the polymer molecule.

[0017] "Wire" and like terms refers to a single strand of conductive metal, e.g., copper or aluminum, or a single strand of optical fiber.

TEST METHODS

Density

[0018] Density is determined according to ASTM D792 with results reported in grams per cubic centimeter, (g/cc).

Differential Scanning Calorimetry (Crystallinity, Melting Point, Crystallization Temperature)

[0019] Differential Scanning Calorimetry ("DSC") is used to measure crystallinity in the polymers (e.g., ethylene-based (PE) polymers). About 5 to 8 mg of polymer sample is weighed and placed in a DSC pan. The lid is crimped on the pan to ensure a closed atmosphere. The sample pan is placed in a DSC cell, and then heated, at a rate of approximately 10°C/min, to a temperature of 180°C for polyethylene (or "PE") (230°C for polypropylene or "PP"). The sample is kept at this temperature for three minutes. Then the sample is cooled at a rate of 10°C/min to -60°C for PE (-40°C for PP), and kept isothermally at that temperature for three minutes. The sample is next heated at a rate of 10°C/min, until complete melting (second heat). The percent crystallinity is calculated by dividing the heat of fusion (H_f), determined from the second heat curve, by a theoretical heat of fusion of 292 J/g for PE (165 J/g, for PP), and multiplying this quantity by 100 (for example, % cryst. = $(H_f/292 \text{ J/g}) \times 100$ (for PE)).

[0020] Unless otherwise stated, melting point(s) (T_m) of each polymer is determined from the second heat curve (peak T_m), and the crystallization temperature (T_c) is determined from the first cooling curve (peak T_c). Glass transition temperature, T_g , is determined from the DSC heating curve where half the sample has gained the liquid heat capacity as described in Bernhard Wunderlich, *The Basis of Thermal Analysis, in Thermal Characterization of Polymeric Materials* 92, 278–279 (Edith A. Turi ed., 2d ed. 1997). Baselines are drawn from below and above the glass transition region and extrapolated

through the T_g region. The temperature at which the sample heat capacity is half-way between these baselines is the T_g.

Drop Point

[0021] Drop point is determined according to ASTM D127 with results reported in degrees Celsius (°C).

[0022] Flash point refers to the lowest temperature at which a volatile liquid can vaporize to form an ignitable mixture in air but will not continue to burn (compare to fire point). Flash point is measured in accordance with ASTM D3278 with results reported in degrees Celsius (°C).

Gel Permeation Chromatography

[0023] A high-temperature gel permeation chromatography ("GPC") system is employed, equipped with Robotic Assistant Deliver ("RAD") system for sample preparation and sample injection. The concentration detector is an Infra-red detector (IR4) from Polymer Char Inc. (Valencia, Spain). Data collection is performed using Polymer Char DM 100 Data acquisition box. The carrier solvent is 1,2,4-trichlorobenzene ("TCB"). The system is equipped with an on-line solvent degas device from Agilent. The column compartment is operated at 150°C. The columns are four Mixed A LS 30-cm, 20-micron columns. The solvent is nitrogen-purged TCB containing approximately 200 ppm 2,6-di-t-butyl-4-methylphenol ("BHT"). The flow rate is 1.0 mL/min, and the injection volume is 200 microliters (μl). A 2 mg/mL sample concentration is prepared by dissolving the sample in nitrogen-purged and preheated TCB (containing 200 ppm BHT) for 2.5 hours at 160°C with gentle agitation.

[0024] The GPC column set is calibrated by running twenty narrow molecular weight distribution polystyrene ("PS") standards. The molecular weight ("MW") of the standards ranges from 580 to 8,400,000 g/mol, and the standards are contained in six "cocktail" mixtures. Each standard mixture has at least a decade of separation between individual molecular weights. The equivalent polypropylene ("PP") molecular weights of each PS standard are calculated by using the following equation, with reported Mark-Houwink coefficients for polypropylene (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 (E.P. Otocka, R.J. Roe, N.Y. Hellman, P.M. Muglia, Macromolecules, 4, 507 (1971)):

$$M_{PP} = \left(\frac{K_{PS} M_{PS}^{a_{PS}+1}}{K_{PP}} \right)^{\frac{1}{a_{PP}+1}} \quad (\text{Eq 1}),$$

where M_{pp} is PP equivalent MW, M_{ps} is PS equivalent MW, $\log K$ and a values of Mark-Houwink coefficients for PP and PS are listed below.

Polymer	a	$\log K$
Polypropylene	0.725	-3.721
Polystyrene	0.702	-3.900

[0025] A logarithmic molecular weight calibration is generated using a fourth order polynomial fit as a function of elution volume. Number average and weight average molecular weights are calculated according to the following equations:

$$M_n = \frac{\sum^i Wf_i}{\sum^i (Wf_i/M_i)} \quad (\text{Eq 2}), \quad M_w = \frac{\sum^i (Wf_i * M_i)}{\sum^i (Wf_i)} \quad (\text{Eq 3}),$$

where Wf_i and M_i are the weight fraction and molecular weight of elution component i , respectively.

Melt Index

[0026] Melt index, or I_2 , is measured in accordance with ASTM D1238, condition 190°C/2.16 kg, and is reported in grams eluted per 10 minutes (g/10 min). The I_{10} is measured in accordance with ASTM D1238, condition 190°C/10 kg, and is reported in grams eluted per 10 minutes (g/10 min).

Melt Flow Rate

[0027] Melt flow rate (MFR) in g/10 min is measured in accordance with ASTM D1238 (230°C/2.16 kg).

Viscosity

[0028] Apparent viscosity for the flooding composition is determined according to ASTM D3236 at 150°C and is reported in centipoise (cP). Kinematic viscosity can be calculated by using apparent viscosity divided by fluid density. Kinematic viscosity is reported in Stokes (St) or centiStokes (cSt).

[0029] Brookfield viscosity of polymer components (*i.e.*, polyolefin elastomers) is determined in accordance with the following procedure using a Brookfield Laboratories DVII+Viscometer in disposable aluminum sample chambers. The spindle used is an SC-31 hot-melt spindle, suitable for measuring viscosities in the range of from 10 to 100,000 centipoise (0.1 to 1,000 grams/(cm.second)). A cutting blade is employed to cut samples into pieces small enough to fit into the 1-inch wide, 5-inches long (2.5-cm wide, 13-cm long) sample chamber. The sample is placed in the chamber, which is in turn inserted into a Brookfield Thermosel and locked into place with bent needle-nose pliers. The sample chamber has a notch on the bottom that fits the bottom of the Brookfield Thermosel to ensure that the chamber is not allowed to turn when the spindle is inserted and spinning. Based on the material to be tested, the sample is heated to a target temperature, typically 150°C, or 176°C, or 176.6°C, or 177°C, or 190°C (other temperatures may be used), with additional sample being added until the melted sample is about 1 inch (2.5 cm) below the top of the sample chamber. The viscometer apparatus is lowered and the spindle submerged into the sample chamber. Lowering is continued until brackets on the viscometer align on the Thermosel. The viscometer is turned on and set to a shear rate, which leads to a torque reading in the range of 30 to 60 percent. Readings are taken every minute for about 15 minutes, or until the values stabilize, then the final reading is recorded.

Oil Separation

[0030] After mixing the samples as described above, 50 milliliters (ml) of the melted sample is poured into a shallow aluminum pan and the sample is allowed to cool and solidify. Any oil separation will be visible on the surface after sitting for 24 hours at room temperature and the result is recorded.

[0031] Pour point refers to the lowest temperature at which a liquid becomes semi-solid and loses its flow characteristics, or in other words, the minimum temperature at which a liquid will flow. Pour point is measured in accordance with ASTM D97 with results reported in degrees Celsius (°C).

DETAILED DESCRIPTION

[0032] The present disclosure provides a flooding composition. In an embodiment, the flooding composition includes (A) from 20 wt% to 40 wt% of a polyolefin component. The polyolefin component is composed of (i) a first amorphous polyolefin (APO) and (ii) a second amorphous polyolefin (APO). The second APO is different than the first APO. The flooding composition also includes (B) from 30 wt% to 60 wt% of a bio-based oil. The flooding composition also includes (C) from 15 wt% to 45 wt% of a polysiloxane. The aggregate of components (A), (B), and (C) amount to 100 wt% of the flooding composition.

A. Amorphous polyolefin

[0033] The present flooding composition includes a polyolefin component composed of (i) a first amorphous polyolefin and (ii) a second amorphous polyolefin. An “amorphous polyolefin” (or “APO”) is an ethylene-based polymer or a propylene-based polymer having a melt viscosity from 30 centipoise (cP) to 50,000 cP at 190°C and a glass transition temperature (T_g) from -80°C to 0°C.

[0034] The first APO is different than the second APO. In other words, the first APO differs in one or more chemical properties and/or one or more physical properties compared to the respective chemical property or physical property of the second APO. Nonlimiting examples of properties which may differ between the first APO and the second APO include composition, comonomer type, comonomer content, density, melt viscosity, T_g, softening point, and any combination thereof.

[0035] The present composition includes from 20 wt% to 40 wt% of the polyolefin component, based on total weight of the flooding composition. In an embodiment, the present composition includes from 20 wt%, or 25 wt%, or 30 wt% to 35 wt%, or 40 wt% of the polyolefin component.

[0036] Within the polyolefin component, the ratio of the first APO to the second APO is from 3:1 to 1:3, based on total weight of the polyolefin component. In an embodiment, the ratio of the first APO to the second APO is from 3:1, or 2:1, or 1:1 to 1:2, or 1:3.

[0037] In an embodiment, the first APO is an ethylene-based polymer. In a further embodiment, the first APO is an APO ethylene/octene copolymer and has one, some, or all of the following properties:

- (i) a density from 0.86 g/cc, or 0.87 g/cc, or 0.875 g/cc to 0.89 g/cc; and/or
- (ii) a Brookfield viscosity at 176.6°C from 5,000 cP, or 6,000 cP to 6,700 cP, or 10,000 cP, or 13,000 cP, or 15,000 cP, or 17,000 cP, or 19,000 cP, or 20,000 cP; and/or
- (iii) a T_m from 65°C, or 68°C to 70°C, or 72°C; and/or
- (iv) a T_g from -60°C, or -58°C to -55°C, or -50°C, or -45°C; and/or
- (v) a T_c from 55°C, or 57 °C to 60°C.

[0038] Nonlimiting examples of suitable APO ethylene-based polymer include AFFINTY GA 1875, AFFINITY GA 1900, AFFINITY GA 1950, and AFFINITY GA 1000R available from The Dow Chemical Company.

[0039] In an embodiment, the second APO is a propylene-based polymer, such as a propylene/ethylene copolymer or a propylene homopolymer. In a further embodiment, the second APO propylene-based polymer is an APO propylene/ethylene copolymer having one, some, or all of the following properties:

- (i) a Brookfield viscosity at 190°C from 200 cP, or 300 cP, or 500 cP, or 1,000 cP to 1,500 cP, or 3,000 cP, or 5,000 cP, or 7,500 cP, or 10,000 cP to 13,000 cP, or 15,000 cP, or 18,000 cP, or 20,000 cP; and/or
- (ii) a Ring and Ball softening point from 120°C, or 125°C, or 130°C to 135°C, or 140°C, or 145°C; and/or
- (iii) a T_g from -40°C, or -35°C, or -30°C to -25°C, or -20°C, or -15°C; and/or
- (iv) a T_c from 90°C, or 93°C to 95°C.

[0040] In an embodiment, the second APO is an APO propylene homopolymer. The APO propylene homopolymer has one, some, or all of the following properties:

- (i) a Brookfield viscosity at 190°C from 500 cP, or 1,000 cP, or 1,500 cP to 2,000 cP, or 2,500 cP, or 3,000 cP; and/or
- (ii) a Ring and Ball softening point from 150°C, or 155°C to 160°C; and/or
- (iii) a T_g from -15°C, or -10°C to -5°C.

[0041] Nonlimiting examples of suitable propylene-based APOs are EASTOFLEX™ amorphous polyolefins available from Eastman Chemical Company.

[0042] In an embodiment, the first APO is an ethylene-based APO and the second APO is a propylene-based APO.

[0043] In an embodiment, the flooding composition and/or the polyolefin component are/is void of, or are/is otherwise free of, butene. The flooding composition and/or the polyolefin component are/is void of, or are/is otherwise free of, polybutene, and/or polyisobutylene, for example.

[0044] In an embodiment, the flooding composition and/or the polyolefin component are/is void of, or are/is otherwise free of, styrene or a composition containing a styrenic-based moiety. The flooding composition and/or the polyolefin component are/is void of, or are/is otherwise free of, styrenic block copolymers, for example.

[0045] In an embodiment, the polyolefin component consists of amorphous polyolefin composed only of, or otherwise composed solely of, (i) propylene monomer and (ii) ethylene monomer.

[0046] In an embodiment, the polyolefin component (*i.e.*, the first APO and the second APO) is the sole polyolefin present in the flooding composition. In other words the polyolefin component (with two different APOs) is present in the flooding composition to the exclusion of other polyolefins.

B. Bio-Based Fluid

[0047] The present flooding composition also includes a bio-based fluid (also referred to as an oil). The oil may be a vegetable oil, a petroleum-based oil, a poly α -olefin oil, and combinations thereof. Nonlimiting examples of suitable vegetable oil include coconut oil, corn oil, cottonseed oil, rapeseed oil (of which canola oil is one variety), olive oil, peanut oil, safflower oil, sesame oil, soybean oil, epoxidized soybean oil (ESO), sunflower oil, mustard oil and algae oil.

[0048] In an embodiment, the bio-based fluid is soybean oil. The soybean oil has one, some, or all of the following properties:

- (i) a viscosity (kinematic) from 30 cSt, or 32 cSt to 35 cSt at 40°C; and/or

- (ii) a flash point from 280°C, or 288°C to 290°C; and/or
- (iii) a pour point from -16°C, or -14°C to -12°C.

[0049] In an embodiment, the soybean oil is an epoxidized soybean oil ("ESO") The ESO has one, some, or all of the following properties:

- (i) a density from 0.930 g/cc, or 0.933 g/cc to 0.94 g/cc; and/or
- (ii) a viscosity (kinematic) from 4.0 stokes, or 4.2 stokes to 4.5 stokes at 25°C; and/or
- (iii) a molecular number (Mn) from 800, or 1,000 to 1,200; and/or
- (iv) an oxirane oxygen value of at least 7%.

[0050] In an embodiment, the bio-based fluid is selected from canola oil, soybean oil (which may or may not be ESO), and combinations thereof.

[0051] In an embodiment, the oil is a petroleum-based oil. Nonlimiting examples of suitable petroleum-based oil include mineral oils (e.g., paraffinic oils, naphthenic oils, and aromatic oils) and low-molecular-weight polyolefin oils (e.g., polybutene oil). In an embodiment, the hydrocarbon oil is a paraffinic oil.

[0052] A nonlimiting example of a suitable commercially available hydrocarbon oil is SUNPAR™ 110, which has a kinematic viscosity of 21.2 cSt at 40°C, available from Sunoco Inc., Pittsburgh, PA, USA.

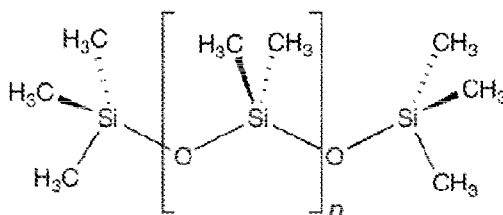
[0053] In an embodiment, the oil is a poly α -olefin oil. A "poly α -olefin oil" ("PAO oil") is a synthetic compound produced by polymerizing at least one α -olefin and is a liquid at 22°C and 1 atmosphere of pressure. The α -olefin may be any α -olefin disclosed herein, such as C₂, C₆, C₈, C₁₀, C₁₂, C₁₄, and C₂₀ α -olefins. These are PAO oils known in the art of flooding compositions. Typical examples of PAO oils include hydrogenated dec-1-ene homopolymer (e.g., DURASYN™ 180I and DURASYN™ 180R, available from INEOS) and hydrogenated 1-tetradecene polymer with 1-dodecene (e.g., DURASYN™ 126, available from INEOS).

C. *Polysiloxane*

[0054] The present composition includes a polysiloxane. A "polysiloxane," as used herein, is an organosilicon compound with two or more Si–O–Si linkages. The polysiloxane

may be (i) a polydimethylsiloxane (or “PDMS”), (ii) a hydroxyl-terminated polydimethylsiloxane (or “PDMS—OH”), and (iii) a combination of (i) and (ii).

[0055] In an embodiment, the polysiloxane is polydimethylsiloxane, hereafter interchangeably referred to as “PDMS.” Polydimethylsiloxane has the Structure (1) below



wherein n is from 1, or 2, or 10, or 100, or 1,000 to 10,000, or 50,000, or 100,000.

[0056] In an embodiment, the PDMS has one, some, or all of the following properties:

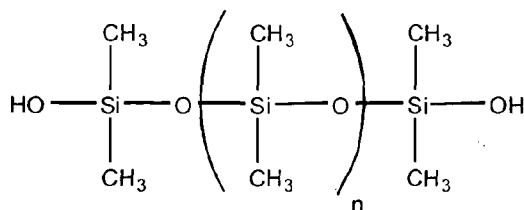
- (i) a number average molecular weight (M_n) from 1,000, or 2,000, or 3,000, or 3,200 to 3,500, or 4,000, or 5,000, or 7,000, or 10,000; and/or
- (ii) a viscosity (kinematic) at 25°C from 20 cSt, or 30 cSt, or 40 cSt, or 50 cSt to 60 cSt, or 70 cSt.

[0057] M_n is measured by gel permeation chromatography (GPC), viscosity is measured using a BROOKFIELD viscometer (Model LVF, Spindle No. 4 at 12 revolutions per minute (rpm)), as described in USP 5,130,041.

[0058] A nonlimiting example of suitable PDMS includes, PMX 200 available from Dow Corning.

[0059] In an embodiment, the present flooding composition includes a hydroxyl-terminated polydimethylsiloxane. A “hydroxyl-terminated polydimethylsiloxane” (or “PDMS—OH”) is a PDMS with terminal hydroxyl groups as shown in Structure 2 below:

Structure (2)



wherein n is from 1, or 2, or 10, or 100, or 1,000 to 10,000, or 50,000, or 100,000.

[0060] In an embodiment, the PDMS-OH has one, some, or all of the following properties:

- (i) a number average molecular weight (M_n) from 2,500, or 2,500 to 3,000, or 3,500, or 4,000; and/or
- (ii) a viscosity (kinematic) at 25°C from 50 cSt, or 60 cSt, or 70 cSt, or 72 cSt to 80 cSt, or 90 cSt; and/or
- (iii) a hydroxyl group content in weight percent (wt%) based on the weight of the OH-PDMS from greater than 0 wt%, or 0.01 wt%, or 0.05 wt%, or 0.07 wt%, or 1.0 wt%, or 1.5 wt% to 2.0 wt%, or 2.5 wt%.

M_n is measured by gel permeation chromatography (GPC), viscosity is measured using a BROOKFIELD viscometer (Model LVF, Spindle No. 4 at 12 revolutions per minute (rpm)), as described in USP 5,130,041. Hydroxyl group content is measured by ^1H NMR spectroscopy or other analytical techniques, similar to the approaches used in *Malaysian Polymer Journal*, Vol. 4, No.2, p 52-61, 2009 and *European Polymer Journal*, Vol. 49, 228–234 (2013).

[0061] Nonlimiting examples of suitable PDMS-OH include, PMX-0156 from Dow Corning, and Q3563 from Dow Corning.

D. Catalyst

[0062] The present flooding composition may include an optional catalyst. When present, the catalyst crosslinks the PDMS-OH by way of silanol condensation. Bounded by no particular theory, it is believed that the crosslinked PDMS-OH component, increases the melt viscosity of the final flooding composition, improves stability of the flooding composition, increases the drop point temperature, and reduces oil separation.

[0063] The catalyst may be added to the PDMS-OH prior to addition of the PDMS-OH to the other components. Alternatively, the catalyst and the PDMS-OH may be added simultaneously with the other components—namely the polyolefin component and the bio-based oil.

[0064] Nonlimiting examples of suitable catalysts include metal carboxylates, such as dibutyltin dilaurate, stannous octoate, stannous acetate, lead naphthenate and zinc octoate; organic metal compounds, such as titanium esters and chelates such as tetrabutyl titanate; organic bases, such as ethylamine, hexylamine and piperidine; and acids, such as mineral acids and fatty acids, and aromatic sulphonic acids.

[0065] In an embodiment, the catalyst is an organic tin compound such as dibutyltin dilaurate, dibutyl dimethoxy tin, dibutyltin bis (2,4-pentanedionate), or stannous octoate. Examples of suitable commercial catalysts in masterbatch form include, without limitation, DFDB 5480NT (a tin catalyst system), DFDA 5488NT (a fast ambient cure catalyst masterbatch) from The Dow Chemical Company, or the Borealis AMBICAT™ system LE 4476.

[0066] In an embodiment, the catalyst is an aromatic sulphonic acid. A nonlimiting example of a suitable aromatic sulphonic acid is Aristonic® acid available from Pilot Chemical Holdings, Inc.

[0067] When the catalyst is present, the flooding composition contains from 0.05 wt%. or 0.1 wt%, or 0.15 wt% to 0.2 wt%, or 0.25 wt%, or 0.3 wt%, of the catalyst, based on total weight of the flooding composition. Curing of the flooding composition, crosslinks the PDMS-OH, thereby increasing the viscosity of the flooding composition.

E. Additives

[0068] In an embodiment the flooding composition can optionally include one or more additives selected such as, but not limited to, antioxidants, rheology modifiers (e.g., thixotropic agents), thickening agents, stabilizers (e.g., UV stabilizers), mineral fillers, polymer fillers, and combinations thereof.

[0069] Antioxidants, when employed, can be present in any conventional amount, such as an amount ranging from 0.01 to 1 wt%, or from 0.01 to 0.3 wt%, based on the total weight of the flooding composition. Suitable antioxidants include, but are not limited to, hindered phenols such as tetrakis[methylene(3,5-di-tert-butyl-4-hydroxyhydrocinnamate)] methane; bis[(beta-(3,5-ditert-butyl-4-hydroxybenzyl)methylcarboxyethyl)]-sulphide, 4,4'-thiobis(2-methyl-6-tert-butylphenol), 4,4'-thiobis(2-tert-butyl-5-methylphenol), 2,2'-

thiobis(4-methyl-6-tert-butylphenol), and thiodiethylene bis(3,5-di-tert-butyl-4-hydroxy)-hydrocinnamate; phosphites and phosphonites such as tris(2,4-di-tert-butylphenyl) phosphite and di-tert-butylphenyl-phosphonite; thio compounds such as dilaurylthiodipropionate, dimyristylthiodipropionate, and distearylthiodipropionate; various siloxanes; polymerized 2,2,4-trimethyl-1,2-dihydroquinoline, n,n'-bis(1,4-dimethylpentyl-p-phenylenediamine), alkylated diphenylamines, 4,4'-bis(alpha, alpha-dimethylbenzyl)diphenylamine, diphenyl-p-phenylenediamine, mixed di-aryl-p-phenylenediamines, and other hindered amine anti-degradants or stabilizers. In an embodiment, the antioxidant is [3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate], commercially available as IRGANOX™ 1035 or Irganox 1010 from BASF.

[0070] Thixotropic agents, when employed, can be present in any conventional amount, such as an amount ranging from greater than 0 to 5 wt%, or 6 wt%, based on the total weight of the flooding composition. An example of a suitable thixotropic agent includes, but is not limited to, fumed silica. Suitable commercial thixotropic agents include, but are not limited to, AEROSIL™ products from Evonik Corp. BYK Industries and Kusumoto Chemicals also supply suitable commercial thixotropic agents.

[0071] Nonlimiting examples of thickening agent, when employed, include Kraton™ polymer such as SEP(S), SBS, SEBS copolymers.

[0072] Nonlimiting examples of fillers, when employed, include inorganic fillers such as silica, calcium carbonate, and combinations thereof.

[0073] In an embodiment, the flooding composition is free of, or is substantially free of, thixotropic agents. As used herein, the term "substantially free" shall mean a concentration of less than 10 parts per million by weight based on the total weight of the flooding composition.

[0074] In an embodiment, the flooding composition includes one or more fillers. Such fillers include, but are not limited to, hollow microspheres (e.g., glass or polymeric), mineral inorganic compounds, polymeric fillers, and the like. When employed, fillers can be present in any conventional amount, such as an amount ranging from greater than 0 up to 60 wt%.

F. Flooding Composition

[0075] The flooding composition is prepared by compounding the polyolefin component, the bio-based oil, the polysiloxane and the catalyst (when present). For instance, the polyolefin component, the bio-based fluid, and the polysiloxane and any optional additives can be compounded in a liquid operational mixer with temperature control. For instance, the ingredients can be compounded in a batch or continuous mixer. Suitable batch mixers include, but are not limited to, Banbury™, Silverson™, Dynamix™ tank mixers and agitators, and Littleford™ batch mixers. Continuous mixers include twin and single-screw extruders, Farrel™ mixers, and Buss™ co-kneaders.

[0076] The above-described polyolefin component is present in the flooding compound in an amount ranging from 20 wt%, or 25 wt%, or 30 wt% to 35 wt%, or 40 wt% based on the total weight of the flooding component. Within the aforementioned polyolefin component weight percent range, the ratio of the first APO to the second APO is from 3:1 to 1:3. The APO ratio is based on total weight of the polyolefin component. In an embodiment, the ratio of the first APO to the second APO is from 3:1, or 2.5:1, or 2:1, or 1.5:1, or 1:1 to 1:1.5, or 1:2, or 1:2.5, or 1:3.

[0077] The above-described bio-based fluid is present in the flooding composition in an amount ranging from 30 wt%, or 35 wt%, or 40 wt%, or 45 wt% to 50 wt%, or 55 wt%, or 60 wt%, based on the total weight of the flooding composition.

[0078] The above-described polysiloxane is present in the flooding composition in an amount ranging from 15 wt%, or 20 wt%, or 25 wt% to 30 wt%, or 35 wt%, or 40 wt%, based on total weight of the flooding composition.

[0079] The above-described catalyst (when present) is present in the flooding composition in an amount ranging from 0.05 wt%, or 0.1 wt% to 0.15 wt%, or 0.2 wt%, or 0.25 wt%, or 0.3 wt%, of the catalyst, based on total weight of the flooding composition.

[0080] The resulting flooding composition has an apparent viscosity from 200 cP, or 300 cP, or 400 cP, or 500 cP, or 750 cP, or 900 cP to 1,000 cP, or 1,100 cP, or 1,200 cP, or 1,300 cP, or 1,400 cP, or 1,500 cP, or 1,600 cP, or 1,700 cP, or 1,800 cP, as measured at 150°C in accordance with ASTM D3236.

[0081] In an embodiment, the flooding composition has a drop point greater than or equal to 90°C. In a further embodiment, the flooding composition has a drop point from 90°C, or 95°C, or 100°C, or 110°C, or 120°C, or 130°C to 140°C, or 150°C, or 160°C, or 170°C, or 180°C. Drop point is determined according to ASTM D127.

[0082] In an embodiment, the flooding composition has an oil separation when aged for 24 hours at 21°C of less than 0.1, or less than 0.05, or less than 0.01. In a further embodiment, the flooding composition has an oil separation when aged for 24 hours at 21°C from 0, or greater than 0, or 0.01 to 0.05, or less than 0.1. In yet a further embodiment, the flooding composition has no (*i.e.*, 0) oil separation when aged for 24 hours at 21°C. Oil separation is determined according to ASTM D1742.

[0083] In an embodiment, the flooding composition contains:

(A) from 20 wt% to 30 wt%, or 35 wt%, or 40 wt% of the polyolefin component composed of the blend of the first APO and the second APO;

(B) from 30 wt%, or 40 wt% to 50 wt%, or 55 wt% of a bio-based fluid selected from soybean oil or canola oil;

(C) from 15 wt%, or 20 wt%, or 25 wt% to 30 wt%, or 35 wt% of a PDMS;

wherein the aggregate of components (A), (B), and (C) amount to 100 wt% of the flooding composition; and the flooding composition has one, some, or all of the following properties:

(i) an apparent viscosity (at 150°C) from 200 cP, or 250 cP, or 500 cP, or 750 cP to 1,000 cP, or 1,250 cP, or 1,300 cP, or 1,350 cP; and/or

(ii) a drop point from 90°C, or 100°C, or 110°C to 120°C, or 130°C, or 140°C, or 150°C; and/or

(iii) an oil separation when aged for 24 hours at 21°C from 0 to 0.01, or less than 0.1, and hereafter referred to as *Compound1*.

[0084] In an embodiment, the *Compound1* polyolefin component contains from 15 wt% to 20 wt% of the first APO that is an APO ethylene-based polymer and from 15 wt% to 20 wt% of the second APO that is an APO propylene-based polymer, wherein weight percent is based on total weight of *Compound1*. In a further embodiment, the ratio of the

APO ethylene-based polymer to the APO propylene-based polymer is 1:1, based on total weight of the polyolefin component.

[0085] In an embodiment, the flooding composition contains:

(A) from 20 wt% to 30 wt%, or 35 wt%, or 40 wt% of the polyolefin component composed of the blend of the first APO and the second APO;

(B) from 30 wt%, or 40 wt% to 50 wt%, or 55 wt% of a bio-based fluid selected from soybean oil or canola oil;

(C) from 30 wt%, or 35 wt% to 40 wt% of a PDMS—OH;

wherein the aggregate of components (A), (B), and (C) amount to 100 wt% of the flooding composition; and the flooding composition has one, some, or all of the following properties:

(i) an apparent viscosity (at 150°C) from 400 cP, or 450 cP to 475 cP, or 500 cP; and/or

(ii) a drop point from greater than 90°C, or greater than 100°C, or greater than 110°C to 120°C, or 130°C, or 140°C, or 150°C; and/or

(iii) an oil separation when aged for 24 hours at 21°C from 0 to 0.01, or less than 0.1; and hereafter referred to as *Compound2*.

[0086] In an embodiment, the *Compound2* polyolefin component contains from 15 wt% to 20 wt% of the first APO that is an APO ethylene-based polymer and from 15 wt% to 20 wt% of the second APO that is an APO propylene-based polymer, wherein weight percent is based on total weight of *Compound2*. In a further embodiment, the ratio of the APO ethylene-based polymer to the APO propylene-based polymer is 1:1, based on total weight of the polyolefin component.

[0087] In an embodiment, the flooding composition contains:

(A) from 20 wt% to 30 wt%, or 35 wt%, or 40 wt% of the polyolefin component composed of the blend of the first APO and the second APO;

(B) from 20 wt%, or 30 wt%, or 40 wt% to 50 wt%, or 55 wt% of a bio-based fluid selected from soybean oil or canola oil;

(C) from 30 wt%, or 35 wt% to 40 wt% of a PDMS—OH;

(D) from 0.1 wt% to 0.15 wt%, or 0.2 wt% catalyst;

wherein the aggregate of components (A), (B), (C) and (D) amount to 100 wt% of the flooding composition;

and the flooding composition has one, some, or all of the following properties:

(i) an apparent viscosity (at 150°C) from 350 cP, or 400 cP, or 500 cP to 750 cP, or 1,000 cP, or 1,500 cP, or 2,000 cP; and/or

(ii) a drop point from 90°C, or 100°C, or 110°C to 120°C, or 130°C, or 140°C, or 150°C, or 160°C, or 170°C; and/or

(iii) an oil separation when aged for 24 hours at 21°C from 0 to 0.01, or less than 0.1; and hereafter referred to as *Compound3*.

[0088] In an embodiment, the *Compound3* polyolefin component contains from 15 wt% to 20 wt% of the first APO that is an APO ethylene-based polymer and from 15 wt% to 20 wt% of the second APO that is an APO propylene-based polymer, wherein weight percent is based on total weight of *Compound3*. In a further embodiment, the ratio of the APO ethylene-based polymer to the APO propylene-based polymer is 1:1, based on total weight of the polyolefin component.

[0089] In an embodiment, the flooding composition contains:

(A) from 20 wt% to 30 wt%, or 35 wt%, or 40 wt% of the polyolefin component composed of the blend of the first APO and the second APO;

(B) from 20 wt%, or 30 wt% to 35 wt%, or 40 wt%, of a bio-based fluid selected from soybean oil or canola oil;

(Ci) from 1 wt%, or 3 wt% to 5 wt%, or 7 wt% of a PDMS—OH;

(Cii) from 20 wt%, or 25 wt% to 30 wt%, or 35 wt% of a PDMS;

(D) from 0.1 wt% to 0.15 wt%, or 0.2 wt% catalyst;

wherein the aggregate of components (A), (B), (C) and (D) amount to 100 wt% of the flooding composition;

and the flooding composition has one, some, or all of the following properties:

(i) an apparent viscosity (at 150°C) from 700 cP, or 750 cP to 800 cP; and/or

(ii) a drop point from 90°C, or 100°C, or 110°C to 120°C, or 130°C, or 140°C, or 150°C; and/or

(iii) an oil separation when aged for 24 hours at 21°C from 0 to 0.01, or less than 0.1; and hereafter referred to as *Compound4*.

[0090] In an embodiment, the *Compound4* polyolefin component contains from 15 wt% to 20 wt% of the first APO that is an APO ethylene-based polymer and from 15 wt% to 20 wt% of the second APO that is an APO propylene-based polymer, wherein weight percent is based on total weight of *Compound4*. In a further embodiment, the ratio of the APO ethylene-based polymer to the APO propylene-based polymer is 1:1, based on total weight of the polyolefin component.

G. Fiber Optic Cable

[0091] In an embodiment, a fiber optic cable, also known as an optical fiber cable, can be prepared that comprises at least one optical fiber, a plurality of buffer tubes, and the above-described flooding composition.

[0092] A cross-sectional view of a common loose-buffer-tube optical fiber cable is shown in Figure 1. In this design of optical fiber cable 1, buffer tubes 2 are positioned radially around a central strength member 4, with a helical rotation to the tubes in the axial length. The helical rotation allows bending of the cable without significantly stretching the tube or the optic fibers 6.

[0093] If a reduced number of buffer tubes is required, then foamed filler rods can be used as low-cost spacers to occupy one or more empty buffer tube positions 10 to maintain cable geometry. The cable jacket 14 can generally be fabricated from a polyethylene-based material.

[0094] The above-described flooding composition can be used to fill the void spaces 8 surrounding optic fibers 6 within buffer tubes 2. Additionally, the flooding composition can be used to fill void spaces surrounding and between the buffer tubes 2, but within the cable jacket 14. The flooding composition provides the suspension and protection needed in the immediate environment surrounding the fibers, including eliminating air space. The

flooding composition also provides a barrier against water penetration, which is detrimental to optic transmission performance.

[0095] Many other buffer tube cable designs are possible. The size and materials of construction for the central strength and tensile member, the dimensions and number of buffer tubes, and the use of metallic armors and multiple layers of jacketing material are among the design elements. Such designs that incorporate a flooding composition are contemplated within the scope of the present disclosure.

[0096] In an embodiment, the buffer tubes are formed from polypropylene copolymer (cPP) (such as ESCORENE™ 7132, an impact copolymer available from Exxon Chemical Company).

[0097] In an embodiment, the cable jacket is formed from a high density polyethylene (HDPE) (such as DGDA-6318BK, available from The Dow Chemical Company, having a density of 0.954 g/cm³). A "high density polyethylene" (or "HDPE") is an ethylene-based polymer having a density of at least 0.94 g/cc, or from at least 0.94 g/cc to 0.98 g/cc. The HDPE has a melt index from 0.1 g/10 min to 25 g/10 min, measured in accordance with ASTM D1238, condition 190°C/2.16 kg.

[0098] An optical fiber cable, such as those described above, can typically be made in a series of sequential manufacturing steps. Optical transmission fibers are generally manufactured in the initial step. The fibers can have a polymeric coating for mechanical protection. These fibers can be assembled into bundles or ribbon cable configurations or can be directly incorporated into the cable fabrication.

[0099] Optical protective components can be manufactured using an extrusion fabrication process. Typically, a single screw plasticating extruder discharges a fluxed and mixed polymer under pressure into a wire and cable cross-head. The cross-head turns the melt flow perpendicular to the extruder and shapes the flow into the molten component. For buffer and core tubes, one or more optic fibers or fiber assemblies and flooding composition are fed into the back of the cross-head and exit the cross-head within the molten tube that is then cooled and solidified in a water trough system. This component is eventually collected as a finished component on a take-up reel.

[00100] To fabricate components made from two or more material layers, there typically would be separate plasticating extruders feeding the melt compositions into a multi-layer cross-head where it is shaped into the desired multi-layer construction.

[00101] Slotted core members and other profile extrusion components are typically extruded in a similar profile extrusion process incorporating an appropriate shaping die, and then subsequently combined with the optical fiber components to fabricate the finished cable.

[00102] To control excess fiber length, a tensioning system is used to feed the fiber components into the tube fabrication process. In addition, component materials selection, the tube extrusion and cross-head equipment, and processing conditions are optimized to provide a finished component where post extrusion shrinkage does not result in excessive slack in the optic fiber components.

[00103] The extruded optical protective components, along with other components such as central components, armors, wraps, are then subsequently processed in one or more steps to produce the finished cable construction. This typically includes processing on a cabling line where the components are assembled with a fabricating extruder/crosshead then used to apply the polymeric jacketing.

[00104] By way of example, and not limitation, some embodiments of the present disclosure will now be described in detail in the following Examples.

EXAMPLES

[00105] Materials used in the comparative samples (CS) and in the inventive examples (IE) are provided in Table 1 below.

Table 1. Materials and Properties

Component	Specification / Properties	Source
AFFINITY™ GA 1875 APO ethylene-based polymer (1 st APO)	ethylene/1-octene copolymer crystallinity = 21.7 wt% Brookfield Viscosity = 6,700 cP (@176.6°C) M _n = 7,210 C ₂ wt% = 63.7 wt% density = 0.870 g/cc T _g = -57°C T _m = 70°C	The Dow Chemical Company
EASTOFLEX™ P1010 APO propylene homopolymer (2 nd APO)	amorphous propylene homopolymer (hPP) Brookfield Viscosity = 1,000 cP (@190°C) Ring and Ball softening point 155°C T _g = -10°C	Eastman
PMX-0156 Silanol fluid (also known as Q3563) PDMS—OH	Mn = 3500 g/mol Flash point 117.7°C (closed cup) Relative density = 0.975 g/cc Brookfield Viscosity at 25°C = 72 cSt Hydroxyl ≤2.5%	Dow Corning
PMX 200 PDMS oil	Viscosity 50 cSt at 25°C Flash point >326°C open cup Pour point -65°C Mn = 3200 Density 0.96 g/cc	Dow Corning
Soybean oil (SO) (bio-based oil)	Viscosity is 32 cSt at 40°C Flash point is 288°C Pour point is -14°C Total unsaturated fatty acids about 81%	Cargill
Canola oil Bio-based oil	Canola oil Viscosity 42 cSt at 40°C Flash pt 315°C 88% unsaturated fatty acids	
Aristonic Acid	Aromatic sulphonic acid catalyst Flash pt > 113°C (closed cup) Pour pt 28°C Viscosity 13.9 cSt at 50°C	Pilot Chemical

1. *Flooding compositions with no catalyst*

[00106] The 1st APO and the 2nd APO are heated and melted in steel paint cans on hot plate equipped with a three blade overhead lab stirrer. The 1st APO and the 2nd APO are

heated to 160-170°C while stirring and then allowed to cool to 100°C. The bio-based oil is then added to the mixture along with the polysiloxane while stirring. The mixture is then heated to 180-190°C for 15 minutes while stirring.

[00107] Properties of comparative samples (CS) and inventive examples (IE) are shown in Table 2 below.

Table 2.

Component ¹	IE8	IE9	CS10	CS11	CS12	CS13	IE10	CS14	CS15	CS16	IE11	CS17	CS18	CS19	CS20	CS21	CS22
AFFINITY™ GA 1875	15	15	15	15	15	15	15	10	20	10	20	5	15	10	20	10	30
EASTOFLEX™ P1010	15	15	15	15	15	15	15	10	20	10	20	15	5	20	10	30	10
SO					25	30	55	45	25	35	35	45	45	35	35	25	25
Canola Oil	35	35	20	20													
PMX-0156 (PDMS-OH)		35		50													
PMX 200 (PDMS))	35		50		45	40	15	35	35	45	25	35	35	35	35	35	35
Total (wt%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Brookfield viscosity at 150°C (cP) ²	740	478	1450	3407	>990	875	245	260	1710	205	1310	155	130	260	400	880	
Drop Point (°C) ⁵	140	140					120				140						
Consistency ³	P	P					P				P						
Oil Separation ⁴	N	N					N				N						

CS = Comparative Sample

IE = Inventive Example

¹Component amounts are wt% based on total weight composition.

²Apparent viscosity of the composition is measured in accordance with ASTM D3236 at 150°C (1 cps = 1 cP).

³Consistency of the composition is visually determined while the composition is at 21°C. P = Paste. S = Solid. W = Waxy. H = Hard.

⁴Oil separation is measured after aging for 24 hours at 21°C according to ASTM D1742. Y = Yes. S = Slight. VS = Very Slight. N = None.

O=Oil Separation.

⁵Drop Point (°C) is measured in accordance ASTM D127.

2. Flooding compositions with catalyst

[00108] The Aristonic acid catalyst is mixed into the polysiloxane fluid at room temperature for about 5 minutes using a three bladed lab stirrer to ensure even distribution before reacting.

[00109] The 1st APO and the 2nd APO are heated and melted in steel paint cans on hot plate equipped with a three blade overhead lab stirrer. The 1st APO and the 2nd APO are heated to 160-170°C while stirring and then allowed to cool to 100°C. The bio-based oil is then added to the mixture along with the along with the polysiloxane fluid/catalyst mixture while stirring. The mixture is then heated to 180-190°C for 15 minutes while stirring.

[00110] Properties of comparative samples (CS) and inventive examples (IE) are shown in Table 3 below.

Table 3.

Component ¹	IE1	CS1	CS2	CS3	CS4	IE2	CS5	CS6	IE3	IE4	IE5	IE6	IE7	CS7	CS8	CS9
AFFINITY™ GA 1875	15	15	15	15	15	15	15	15	15	15	14.85	14.85	14.85	15		
EASTOFLEX™ P1010	15	15	15	15	15	15	15	15	15	15	15	15	15	15		
SO	35		5	10	20	35		20	34.85	35		20	50			
PMX-0156 (PDMS-OH)						35	70	50	35	5	70	50	20	5	100	99.85
PMX 200 (PDMS)	35	70	65	60	50					29.85				64.85		
Aristonic Acid									0.15	0.15	0.15	0.15	0.15	0.15		0.15
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Brookfield viscosity at 150°C (cP) ²	1120	45	280	600	1390	509	>90511	2906	710	760	1700	863	371	245		954
Drop Point (°C) ⁵	130					100			160	140	170	90	120			
Consistency ³	P					P			P	P	P	P	P			
Oil Separation ⁴	N	O	O	O	O	N	O	O	N	N	N	N	N	O	N/A	N/A
Brookfield Viscosity at 100°C (cP)															10.6	4010

CS = Comparative Sample

IE = Inventive Example

¹Component amounts are wt% based on total weight composition.²Apparent viscosity of the composition is measured in accordance with ASTM D3236 at 150°C (1 cps = 1 cP).³Consistency of the composition is visually determined while the composition is at 21°C. P = Paste. S = Solid. W = Waxy. H = Hard.⁴Oil separation is measured after aging for 24 hours at 21°C according to ASTM D1742. Y = Yes. S = Slight. VS = Very Slight. N = None.

O=Oil Separation.

⁵Drop Point (°C) is measured in accordance ASTM D127.

[00111] CS8 and CS9 are comparative samples showing the effect the catalyst has on the viscosity of the silanol fluid. The catalyst containing silanol fluids in CS8 and CS9 are made by mixing the catalyst into the silanol fluid at room temperature first and then heating to 180-190°C for 15 minutes while stirring.

[00112] CS1 and CS5 show that when 70 wt% PMX200 polydimethylsiloxane or 70 wt% PDMS—OH oil is used without soybean oil the result is a product with oil separated

from the polymer and no stable gel is formed. Oil separation also occurs with samples containing 5, 10 and 20 wt% soybean oil (samples CS2,CS3,CS4). However, with 35 wt% soybean oil and 35 wt% PDMS in IE1 a stable gel is formed (*i.e.*, no oil separation in IE1). A stable gel can also be formed if PDMS—OH (PMX-0156) is used at 35 wt% in combination with 35wt% soybean oil instead of the PMX-200 PDMS as shown with IE2 (*i.e.*, no oil separation in IE2). IE5 shows that the results can change to a stable gel (no oil separation) by the addition of the catalyst (aristonic acid) when comparing to CS1 and CS5 (oil separation observed).

[00113] CS6 also shows oil separation at similar levels of soybean oil and polysiloxane as CS4. IE6 shows that the results change to a stable gel by the addition of the catalyst (aristonic acid) when comparing IE6 to CS6 and CS4. Although both IE2 and IE3 form stable gels the results of IE3 show that the drop point is improved by the addition of the catalyst.

[00114] IE4 shows that a combination of the two different polysiloxanes can be used with 35 wt% soybean oil and produce a stable gel.

[00115] IE6 and IE7 show that different ranges of soybean oil and PDMS—OH can produce stable gels. CS7 with 70 wt% total polysiloxane shows similar oil separation results as CS1. The last two samples CS8 and CS9 are comparative examples showing the effect the catalyst has on the viscosity of the silanol fluid which is seen in dramatic increase in sample CS9. The CS9 sample is made by mixing the catalyst into the polysiloxane fluid at room temperature first and then heating to 180-190°C and holding at that temperature for 15 minutes while stirring.

[00116] 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

What is claimed is:

1. A flooding composition comprising in weight percent (wt%) based on the weight of the composition:
 - (A) from 20 wt% to 40 wt% of a polyolefin component comprising
 - (i) a first amorphous polyolefin (APO), and
 - (ii) a second APO different than the first APO;
 - (B) from 30 wt% to 60 wt% of a bio-based oil; and
 - (C) from 15 wt% to 45 wt% of a polysiloxane.
2. The flooding composition of claim 1 wherein the first APO is an ethylene-based polymer and the second APO is a propylene-based polymer.
3. The flooding composition of claim 2 wherein the ratio of the first APO to the second APO is from 3:1 to 1:3 based on total weight of the polyolefin component.
4. The flooding composition of claim 1 wherein the bio-based oil is selected from the group consisting of soybean oil, canola oil, and combinations thereof.
5. The flooding composition of claim 1 wherein the polysiloxane is selected from the group consisting of polydimethylsiloxane, hydroxyl-terminated polydimethylsiloxane, and combinations thereof.
6. The flooding composition of claim 1 wherein the flooding composition has an apparent viscosity from 200 cP to 1,800 cP at 150°C, as measured in accordance with ASTM D3236.
7. The flooding composition of claim 6 having a drop point greater than or equal to 90°C, as measured in accordance with ASTM D127.
8. The flooding composition of claim 1 wherein the polysiloxane comprises a hydroxyl-terminated polydimethylsiloxane; and
the flooding composition further comprises a catalyst.

9. The flooding composition of claim 8 wherein the flooding composition has an apparent viscosity from 300 cP to 1,800 cP.

10. The flooding composition of claim 8 wherein the flooding composition has a drop point from greater than or equal to 90°C to 180°C as measured in accordance with ASTM D127.

11. The flooding composition of claim 1 wherein the flooding composition has no oil separation when aged for 24 hours at 21°C as measured in accordance with ASTM D1742.

12. An fiber optic cable comprising:
a buffer tube;
at least one optical fiber in the buffer tube; and
a flooding composition comprising from 20 wt% to 40 wt% of a polyolefin component comprising

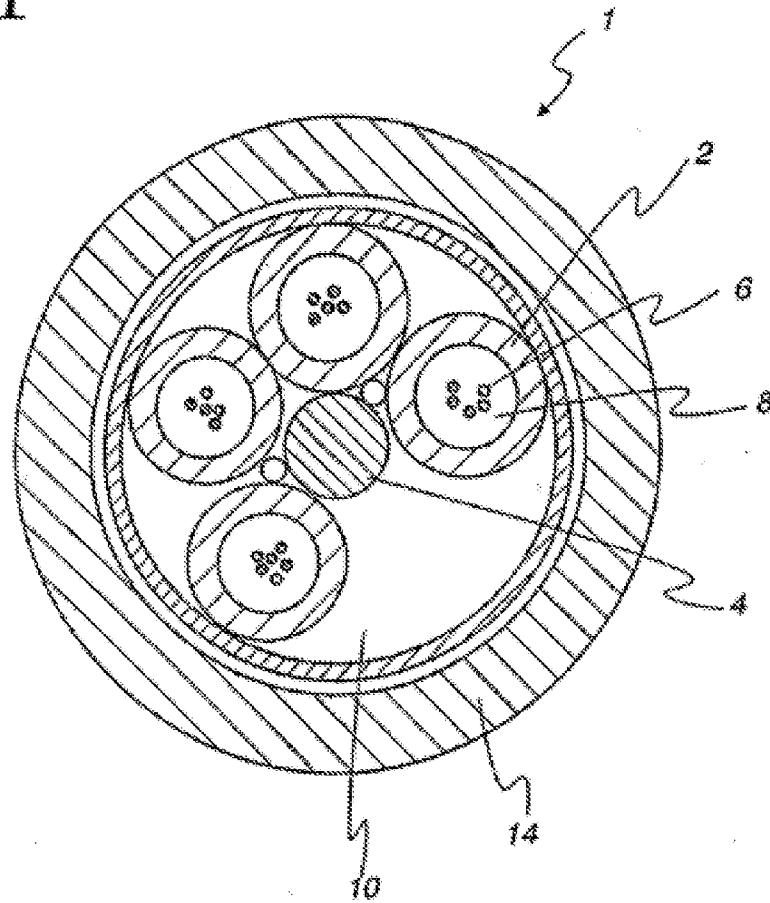
- (i) a first amorphous polyolefin (APO), and
- (ii) a second APO different than the first APO;

from 30 wt% to 60 wt% of a bio-based oil; and

from 15 wt% to 45 wt% of a polysiloxane.

1/1

Fig. 1



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2019/021994

A. CLASSIFICATION OF SUBJECT MATTER
INV. G02B6/44 C08L83/04 C08L91/00
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)
C09J G02B C08L

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

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	WO 2016/160315 A1 (DOW GLOBAL TECHNOLOGIES LLC [US]) 6 October 2016 (2016-10-06) claims; examples -----	1-12
A	WO 2014/209543 A1 (DOW GLOBAL TECHNOLOGIES LLC [US]) 31 December 2014 (2014-12-31) page 4, line 33 - page 6, line 24; claims; example 7 -----	1-12
A	WO 98/13419 A1 (DOW CHEMICAL CO [US]; KELLEY DAVID C [US] ET AL.) 2 April 1998 (1998-04-02) claims; examples; tables 1-4 -----	1-12



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"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

31 May 2019

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2019/021994

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