(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 May 2019 (16.05.2019)

WIPO | PCT

(10) International Publication Number
WO 2019/094667 A1

(51) International Patent Classification:
C08L 23/16 (2006.01) *C08L 25/06* (2006.01)
C08L 53/00 (2006.01) *E21B 33/12* (2006.01)

(21) International Application Number: PCT/US2018/059938

(22) International Filing Date: 09 November 2018 (09.11.2018)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/584,705 10 November 2017 (10.11.2017) US

(71) Applicant: **POLYONE CORPORATION** [US/US]; 33587 Walker Road, Avon Lake, Ohio 44012 (US).

(72) Inventors: **SHAH, Ketan**; c/o PolyOne Corporation, 33587 Walker Road, Avon Lake, Ohio 44012 (US). **CRUZ, Cesar**; c/o PolyOne Corporation, 33587 Walker Road, Avon Lake, Ohio 44012 (US).

(74) Agent: **SAMBROOK, Michael J.** et al.; PolyOne Corporation, 33587 Walker Road, Avon Lake, Ohio 44012 (US).

(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
— *of inventorship (Rule 4.17(iv))*

Published:
— *with international search report (Art. 21(3))*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) Title: POLYOLEFIN ELASTOMER BLENDS FOR ELASTOMERIC FILMS

(57) Abstract: A thermoplastic elastomer compound includes a polyolefin elastomer blend of at least two different polyolefin elastomers, styrene-ethylene/butylene- styrene block copolymer, and plasticizer. The compound has a Melt Flow Rate (230 °C, 2.16 kg) of no less than about 5 g / 10 min and a Melt Flow Rate (190 °C, 2.16 kg) of no less than about 1 g / 10 min. Elastomeric films formed from the compound can be used in place of elastomeric films based on styrene- isoprene- styrene (SIS) block copolymers to make components of disposable hygiene articles.

POLYOLEFIN ELASTOMER BLENDS FOR ELASTOMERIC FILMS

CLAIM OF PRIORITY

[0001] This application claims the benefit of U.S. Provisional Patent Application Serial No. 62/584,705 bearing Attorney Docket Number 12017026 and filed on November 10, 2017, which is hereby incorporated by reference in its entirety.

FIELD OF THE INVENTION

[0002] This invention relates to thermoplastic elastomer compounds including polyolefin elastomer blends. This invention also relates to elastomeric films which are useful for making components of disposable hygiene articles.

BACKGROUND OF THE INVENTION

[0003] Demand exists for disposable hygiene articles and related personal care products. Generally, disposable hygiene articles can include baby care products such as disposable diapers, adult incontinence care products such as disposable undergarments, and feminine care products such as disposable sanitary pads.

[0004] Disposable hygiene articles typically include one or more components made from elastomeric films. To be useful as a component of disposable hygiene articles, elastomeric films often must meet specific requirements for properties such as good softness, very high elasticity, good tensile strength, low hysteresis, low stress-relaxation, and desirable levels of tension at various levels of extension. Further, elastomeric films typically must be capable of high speed processing to enable efficient manufacturing of disposable hygiene articles. Lastly, elastomeric films and the materials from which they are made ideally must be very low cost because the hygiene articles are designed to be disposable.

[0005] Conventionally, disposable hygiene articles are made using elastomeric films formed from materials such as polyisoprene rubber and styrene-isoprene-styrene (SIS) block copolymers. However, these materials have drawbacks. For example, SIS-based elastomeric films can be susceptible to thermal, oxidative, and/or ultraviolet (UV) degradation, which can limit usefulness of SIS-based elastomeric films during both manufacturing and end-product use. Additionally, in some instances, SIS-based elastomeric films can have levels of stress-relaxation and hysteresis that are undesirable.

[0006] Notwithstanding the drawbacks of conventional elastomeric films such as SIS-based elastomeric films, there are barriers to adoption of elastomeric films formed from materials other than SIS for use in making disposable hygiene articles. For example, changes to a material for purposes of improving performance properties of the elastomeric film formed from the material can negatively affect the high speed processability of the elastomeric film. Likewise, changes to a material for purposes of improving high speed processability of the elastomeric film formed from the material can negatively affect the performance properties of the elastomeric film.

[0007] Moreover, commercial manufacturing of disposable hygiene articles and their elastomeric film components can involve relatively costly equipment and relatively complex processes. In many instances, at least some manufacturing equipment or processes are designed or adapted specifically for use of conventional elastomeric films such as SIS-based elastomeric films. Disadvantageously, use of materials other than SIS could require prohibitively costly changes to the incumbent manufacturing equipment or the processes.

SUMMARY OF THE INVENTION

[0008] Consequently, a need exists for thermoplastic elastomer compounds and elastomeric films formed therefrom which are based on elastomers other than styrene-isoprene-styrene (SIS) block copolymers but are compatible with and capable of good high processing using incumbent manufacturing equipment and processes designed or adapted specifically for conventional elastomeric films such SIS-based elastomeric films. Moreover, a need exists for such thermoplastic elastomer compounds and elastomeric films formed therefrom which are not only capable of good high speed processing, but which also possess properties desirable for disposable hygiene articles and are relatively low cost.

[0009] The aforementioned needs are met by one or more aspects of the present invention.

[00010] It has been found that, by combining a blend of at least two different polyolefin elastomers with styrene-ethylene/butylene-styrene block copolymer and plasticizer to provide thermoplastic elastomer compounds having a Melt Flow Rate (230 °C, 2.16 kg) of no less than about 5 g / 10 min and a Melt Flow Rate (190 °C, 2.16 kg) of no less than about 1 g / 10 min, it is possible to achieve elastomeric films that are capable of good high speed processing on incumbent manufacturing equipment and processes designed or adapted specifically for conventional elastomeric films such as SIS-based elastomeric films. Advantageously, in addition to being capable of such good high speed processing, such thermoplastic elastomer compounds and elastomeric films formed therefrom possess properties desirable for disposable hygiene articles, such as good softness, very high elasticity, good tensile strength, low hysteresis, low stress-relaxation, and desirable levels of tension at various levels of extension, while also being relatively low cost.

[00011] In some aspects, the present invention is directed to thermoplastic elastomer compounds that include a polyolefin elastomer blend of at least two different polyolefin elastomers, styrene-ethylene/butylene-styrene block copolymer, and plasticizer. The compounds have a Melt Flow Rate (230 °C, 2.16 kg) of no less than about 5 g / 10 min and a Melt Flow Rate (190 °C, 2.16 kg) of no less than about 1 g / 10 min.

[00012] In other aspects, the present invention is directed to elastomeric films formed from thermoplastic elastomer compounds as described herein.

[00013] In further aspects, the present invention is directed to disposable hygiene articles including elastomeric films as described herein.

[00014] Features of the invention will become apparent with reference to the following embodiments. There exist various refinements of the features noted in relation to the above-mentioned aspects of the present invention. Additional features may also be incorporated in the above-mentioned aspects of the present invention. These refinements and additional features may exist individually or in any combination. For instance, various features discussed below in relation to any of the described aspects of the present invention may be incorporated into any of the described aspects of the present invention alone or in any combination.

EMBODIMENTS OF THE INVENTION

[00015] In some embodiments, the present invention is directed to thermoplastic elastomer compounds. In other embodiments, the present invention is directed to elastomeric films. In further embodiments, the present invention is directed to disposable hygiene articles. Required and optional features of these and other embodiments of the present invention are described.

[00016] As used herein, the term “compound” means a composition or mixture resulting from melt mixing, or compounding, a neat polymer and at least one other ingredient including but not limited to one or more additives, or one or more other polymers, or both.

[00017] As used herein, the terms “formed from” or “forming” mean, with respect to an article (e.g., a film) and a compound, that the article is molded, extruded, calendered, thermoformed, or otherwise shaped from the compound. As such, the terms “formed from” or “forming” mean, in some embodiments, the article can comprise, consist essentially of, or consist of, the compound.

[00018] As used herein, the term “free of” a certain component or substance means, in some embodiments, that no amount of that component or substance is intentionally present, and, in other embodiments, that no functionally effective amount of that component or substance is present, and, in further embodiments, that no amount of that component or substance is present.

[00019] As used herein, the term "Melt Flow Rate" means a melt flow rate according to ASTM D1238 at specified testing conditions.

[00020] As used herein, the term "Melt Flow Rate (190 °C, 2.16 kg)" means a Melt Flow Rate at testing conditions of a temperature of 190 °C and a gravimetric weight of 2.16 kg.

[00021] As used herein, the term "Melt Flow Rate (230 °C, 2.16 kg)" means a Melt Flow Rate at testing conditions of a temperature of 230 °C and a gravimetric weight of 2.16 kg.

[00022] Thermoplastic Elastomer Compound

[00023] Thermoplastic elastomer compounds of the present invention include a polyolefin elastomer blend of at least two different polyolefin elastomers, styrene-ethylene/butylene-styrene block copolymer, and plasticizer.

[00024] According to the present invention, the thermoplastic elastomer compounds have a Melt Flow Rate (230 °C, 2.16 kg) of no less than about 5 g / 10 min and a Melt Flow Rate (190 °C, 2.16 kg) of no less than about 1 g / 10 min.

[00025] In some embodiments, the compound has a Melt Flow Rate (230 °C, 2.16 kg) of no less than about 6 g / 10 min. In other embodiments, the compound has a Melt Flow Rate (230 °C, 2.16 kg) from about 6 to about 15, or from about 7 to about 15, or from about 8 to about 15 g / 10 min.

[00026] In some embodiments, the compound has a Melt Flow Rate (190 °C, 2.16 kg) of no less than about 1.5 g / 10 min. In other embodiments, the compound has a Melt Flow Rate (190 °C, 2.16 kg) from about 1.5 to about 10 g / 10 min. In further embodiments, the compound has a Melt Flow Rate (190 °C, 2.16 kg) from about 2 to about 10 g / 10 min.

[00027] While not intending to be bound by theory, it is believed that compounds having both a Melt Flow Rate (230 °C, 2.16 kg) of no less than about 5 g / 10 min and a Melt Flow Rate (190 °C, 2.16 kg) of no less than about

1 g / 10 min generally can be expected to be capable of good high speed processing on incumbent manufacturing equipment and processes designed or adapted specifically for conventional elastomeric films such as SIS-based elastomeric films for use in making disposable hygiene articles.

[00028] In some embodiments, the compound is free of styrene-isoprene-styrene (SIS) block copolymer given that the thermoplastic elastomer compound of the present invention and elastomeric films formed therefrom can be used instead of SIS-based elastomeric films.

[00029] Polyolefin Elastomer Blend

[00030] Thermoplastic elastomer compounds of the present invention include a polyolefin elastomer blend.

[00031] According to the present invention, the polyolefin elastomer blend includes at least two different types or grades of polyolefin elastomers.

[00032] For example, in some embodiments, the polyolefin elastomer blend includes a first polyolefin elastomer and a second polyolefin elastomer different from the first polyolefin elastomer. In other embodiments, the polyolefin elastomer blend includes a first polyolefin elastomer, a second polyolefin elastomer different from the first polyolefin elastomer, and a third polyolefin elastomer different from each of the first polyolefin elastomer and the second polyolefin elastomer. In further embodiments, the polyolefin elastomer blend further includes a fourth polyolefin elastomer different from each of the first polyolefin elastomer, the second polyolefin elastomer, and the third polyolefin elastomer. Likewise, in even further embodiments, the polyolefin elastomer blend further includes any number of additional polyolefin elastomers each of which are different from each of the other polyolefin elastomers included in the polyolefin elastomer blend, provided that the resulting thermoplastic elastomer compounds have a Melt Flow Rate (230 °C, 2.16 kg) of no less than about 5 g / 10 min and a Melt Flow Rate (190 °C, 2.16 kg) of no less than about 1 g / 10 min.. However, in some embodiments, the polyolefin elastomer blend includes no more than four, or, no more than three, or, no more than two, different polyolefin elastomers.

[00033] While not intending to be limited by theory, it is generally believed that including polyolefin elastomer in the thermoplastic elastomer compound in increasingly greater amounts can have the effect of improving high speed processability, but also it can negatively affect desirable end-use properties such good softness, low stress-relaxation, and low hysteresis. Conversely, it is generally believed that including SEBS block copolymer and plasticizer in the thermoplastic elastomer compound in increasingly greater amounts can have the effect of improving desirable end-use properties such good softness, low stress-relaxation, and low hysteresis, but also it can negatively affect high speed processability. It is further generally believed that by using a blend of at least two different types or grades of polyolefin elastomers, as opposed to using only one type or grade of polyolefin elastomer, it is possible to achieve good high speed processing at a relatively lower total amount of polyolefin elastomer(s) included in the compound, which, in turn, can minimize any negative effect on desirable end-use properties such good softness, low stress-relaxation, and low hysteresis.

[00034] Polyolefin elastomers suitable for use in the polyolefin elastomer blend of the present invention include conventional or commercially available polyolefin elastomers. Each of the at least two different polyolefin elastomers can be selected such that, when combined as described herein with the at least one other polyolefin elastomer, styrene-ethylene/butylene-styrene block copolymer, and plasticizer, the resulting thermoplastic elastomer compound has a Melt Flow Rate (230 °C, 2.16 kg) of no less than about 5 g / 10 min and a Melt Flow Rate (190 °C, 2.16 kg) of no less than about 1 g / 10 min. Additionally, suitable polyolefin elastomers can be selected, at least in part, to provide other properties desirable for the end-use application.

[00035] Non-limiting examples of suitable polyolefin elastomer include propylene-based elastomers, ethylene/α-olefin random copolymers, and combinations thereof.

[00036] Suitable propylene-based elastomers include those described in International Appl. Pub. No. WO 2005/049670 filed by ExxonMobil Chemical.

[00037] For example, in some embodiments, suitable propylene-based elastomers are comprised of (a) at least about 60 weight percent of propylene-derived units, (b) at least about 6 weight percent of ethylene-derived units, and (c) from about 0.3 to about 10 weight percent of diene-derived units, based on a combined weight of the propylene-derived units, the ethylene-derived units, and the diene-derived units.

[00038] Non-limiting examples of commercial available propylene-based elastomers include those available under the VISTAMAXX brand from ExxonMobil Chemical, including but not limited to the following grades: 2330; 3000; 3020; 3980; 6102; 6202; and 6502.

[00039] VISTAMAXX 2330 polypropylene-based elastomers can be further characterized as propylene-based elastomer comprising about 13 weight percent of ethylene-derived units and having a Melt Flow Rate (230 °C, 2.16 kg) of about 290 g / 10 min and a Shore A hardness of about 77 according to ASTM D2240.

[00040] VISTAMAXX 3000 polypropylene-based elastomers can be further characterized as propylene-based elastomer comprising about 11 weight percent of ethylene-derived units and having a Melt Flow Rate (190 °C, 2.16 kg) of about 3.7 g / 10 min and a Shore D hardness of about 27 according to ASTM D2240.

[00041] VISTAMAXX 3020 polypropylene-based elastomers can be further characterized as propylene-based elastomer comprising about 11 weight percent of ethylene-derived units and having a Melt Flow Rate (190 °C, 2.16 kg) of about 1.1 g / 10 min and a Shore D hardness of about 34 according to ASTM D2240.

[00042] VISTAMAXX 3980 polypropylene-based elastomers can be further characterized as propylene-based elastomer comprising about 9 weight percent of ethylene-derived units and having a Melt Flow Rate (190 °C, 2.16 kg) of about 3.6 g / 10 min and a Shore D hardness of about 34 according to ASTM D2240.

[00043] VISTAMAXX 6102 polypropylene-based elastomers can be further characterized as propylene-based elastomers including about 16 weight percent of ethylene-derived units and having a Melt Flow Rate (190 °C, 2.16 kg) of about 1.4 g / 10 min and a Shore A hardness of about 66 according to ASTM D2240.

[00044] VISTAMAXX 6202 polypropylene-based elastomers can be further characterized as propylene-based elastomers including about 15 weight percent of ethylene-derived units and having a Melt Flow Rate (190 °C, 2.16 kg) of about 9.1 g / 10 min and a Shore A hardness of about 66 according to ASTM D2240.

[00045] VISTAMAXX 6502 polypropylene-based elastomers can be further characterized as propylene-based elastomers including about 13 weight percent of ethylene-derived units and having a Melt Flow Rate (190 °C, 2.16 kg) of about 21 g / 10 min and a Shore A hardness of about 71 according to ASTM D2240.

[00046] Suitable ethylene/α-olefin random copolymers include random copolymers formed by polymerizing ethylene with one or more C_3-C_{10} α-olefins such as propylene, 1-butene, 1-pentene, 1-hexene, 4-methyl-1-pentene, 1-heptene, 1-octene, 1-nonene, and 1-decene.

[00047] For example, in some embodiments, suitable ethylene/α-olefin random copolymers include ethylene/propylene copolymers, ethylene/butene copolymers, ethylene/hexane copolymers, and ethylene/octene copolymers.

[00048] Non-limiting examples of commercial available ethylene/α-olefin random copolymers include those available under the ENGAGE brand from Dow Chemical; and those available under the EXACT brand from ExxonMobil Chemical.

[00049] SEBS Block Copolymer

[00050] Thermoplastic elastomer compounds of the present invention include styrene-ethylene/butylene-styrene (SEBS) block copolymer.

[00051] SEBS block copolymers suitable for use in the present invention include conventional and commercially available SEBS block copolymers. Suitable SEBS block copolymer can be selected such that, when combined as described herein with the polyolefin elastomer blend and plasticizer, the resulting thermoplastic elastomer compound has a Melt Flow Rate (230 °C, 2.16 kg) of no less than about 5 g / 10 min and a Melt Flow Rate (190 °C, 2.16 kg) of no less than about 1 g / 10 min.

[00052] In some embodiments, suitable SEBS block copolymer is selected from low molecular weight SEBS block copolymer or medium molecular weight SEBS block copolymer, as represented by SEBS block copolymer having a Melt Flow Rate (230 °C, 5 kg) of no greater than about 1 g / 10 min.

[00053] For example, suitable SEBS block copolymer can have a weight average molecular weight that is, in some embodiments, less than about 500,000, and, in other embodiments, less than about 200,000, and, in further embodiments, less than about 100,000, and, in even further embodiments, less than about 75,000.

[00054] Non-limiting examples of commercially available SEBS block copolymer include those available under the KRATON brand from Kraton Polymers, such as grades G1641, G1650, G1651, and G1654; those available under the SEPTON brand from Kuraray, such as the 8000 series and including grade 8004; and those available under the GLOBALPRENE brand from LCY Chemical, such a grades 9550 and 9551.

[00055] Plasticizer

[00056] Thermoplastic elastomer compounds of the present invention include plasticizer.

[00057] Plasticizers suitable for use in the present invention include conventional and commercially available plasticizers. Suitable plasticizers can be selected such that, when combined as described herein with the polyolefin elastomer blend and SEBS block copolymer, the resulting thermoplastic elastomer compound has a Melt Flow Rate (230 °C, 2.16 kg) of no less than about 5 g / 10 min and a Melt Flow Rate (190 °C, 2.16 kg) of no less than about 1 g / 10 min.

[00058] In some embodiments, suitable plasticizers include any conventional oil, such as white mineral oil, vegetable oil, synthetic oil, and the like, which is capable of plasticizing the polyolefin elastomer and/or the SEBS block copolymer.

[00059] Non-limiting examples of commercially available plasticizer oils include those available under the PURETOL 550 brand from Petro-Canada, and those available under the PRIMOL 382 brand from ExxonMobil.

[00060] Optional Additives

[00061] In some embodiments, thermoplastic elastomer compounds of the present invention further include one or more optional additives.

[00062] Suitable optional additives include conventional or commercially available plastics additives. Those skilled in the art of thermoplastics compounding, without undue experimentation, can select suitable additives from available references, for example, E.W. Flick, "Plastics Additives Database," *Plastics Design Library* (Elsevier 2004).

[00063] Optional additives can be used in any amount that is sufficient to obtain a desired processing or performance property for the thermoplastic elastomer compound and/or the elastomeric film formed therefrom. The amount should not be wasteful of the additive nor detrimental to the processing or performance of the thermoplastic elastomer compound and/or the elastomeric film formed therefrom.

[00064] Non-limiting examples of additives suitable for use in the present invention include one or more selected from antioxidants and stabilizers; bonding agents; colorants such as pigments or dyes; impact modifiers; non-elastomeric thermoplastic polymer; tackifiers; ultraviolet light absorbers; and waxes.

[00065] In some embodiments, non-elastomeric thermoplastic polymer is selected from non-elastomeric polyolefin thermoplastic polymers, non-elastomeric polystyrene-based thermoplastic polymers, and combinations thereof.

[00066] Non-elastomeric thermoplastic polymer can be included, for example, to adjust processability or other properties in the thermoplastic elastomer compound. Suitable non-elastomeric thermoplastic polymer should be compatible with the polyolefin elastomer blend and the SEBS block copolymer.

[00067] Suitable non-elastomeric thermoplastic polymers include conventional and commercially available non-elastomeric polyolefin resins, including homopolymers, copolymers, blends of polymers, mixtures of polymers, alloys of polymers, and combinations thereof. Non-limiting examples of non-elastomeric polyolefin polymers include polyethylene (including low-density (LDPE), high-density (HDPE), ultra-high molecular weight (UHDPE), linear-low-density (LLDPE), very-low density (VLDPE), etc.), polypropylene, polybutylene, polyhexalene, and polyoctene. In some embodiments, non-elastomeric polyolefin polymers is selected from high density polyethylene (HDPE) and/or polypropylene homopolymer (PP). Such polyolefins are commercially available from a number of sources.

[00068] Suitable non-elastomeric thermoplastic polymers also include conventional and commercially available non-elastomeric polystyrene resins, including homopolymers, copolymers, blends of polymers, mixtures of polymers, alloys of polymers, and combinations thereof. Non-limiting examples of non-elastomeric polystyrene-based polymers include polystyrene. Such polystyrenes are commercially available from a number of sources.

[00069] Notwithstanding the above, in some embodiments, the thermoplastic elastomer compound of the present invention is free of non-elastomeric thermoplastic polymer, for example, non-elastomeric polyolefins and non-elastomeric polystyrenes, as an additive ingredient.

[00070] <u>Ranges of Ingredients in the TPE Compounds</u>

[00071] Table 1 below shows ranges of ingredients, in weight percent, which can be acceptable, desirable, and preferable for some embodiments of thermoplastic elastomer (TPE) compounds of the present invention. Weight percent is based on total weight the thermoplastic elastomer compound.

[00072] Thermoplastic elastomer compounds of the present invention, in some embodiments, can comprise, consist essentially of, or consist of these ingredients. Any number between the ends of the ranges is also contemplated as an end of a range, such that all possible combinations are contemplated within the possibilities of Table 1 as embodiments of compounds for use in the present invention. Unless expressly stated otherwise herein, any disclosed number is intended to refer to both exactly the disclosed number and "about" the disclosed number, such that either possibility is contemplated within the possibilities of Table 1 as embodiments of compounds for use in the present invention.

Table 1
Thermoplastic Elastomer Compounds
(Weight Percent)

Ingredient	Acceptable	Desirable	Preferable
Polyolefin Elastomer Blend	20 - 85	50 - 82	75 - 79
SEBS Block Copolymer	10 - 50	11 - 30	12 - 20
Plasticizer	5 - 40	7 - 20	9 - 16
Optional Additives	0 - 12	0 - 9	0 - 5

[00073] <u>Processing</u>

[00074] The preparation of thermoplastic elastomer compounds of the present invention is uncomplicated once the proper ingredients have been selected. The compound can be made in batch or continuous operations.

[00075] Mixing in a continuous process typically occurs in an extruder that is elevated to a temperature that is sufficient to melt the polymer matrix with addition of all additives at the feed-throat, or by injection or side-feeders downstream. Extruder speeds can range from about 200 to about 700 revolutions per minute (rpm), and preferably from about 300 rpm to about 500 rpm. Typically, the output from the extruder is pelletized for later forming, extrusion, molding, thermoforming, foaming, calendering, and/or other processing into plastic articles.

[00076] Subsequent forming such as extrusion, molding, thermoforming, calendering, and/or other processing techniques are well known to those skilled in the art of thermoplastics polymer engineering. Without undue experimentation but with reference to publications such as “Extrusion, The Definitive Processing Guide and Handbook”, “Handbook of Molded Part Shrinkage and Warpage”, “Specialized Molding Techniques”, “Rotational Molding Technology”, and “Handbook of Mold, Tool and Die Repair Welding”, all part of the *Plastics Design Library* series published by Elsevier, one can make articles of any conceivable shape and appearance using compounds of the present invention.

[00077] In some embodiments, thermoplastic elastomer compounds of the present invention are formed by extrusion processes, including co-extrusion processes, into elastomeric films.

USEFULNESS OF THE INVENTION

[00078] Thermoplastic elastomer compounds of the present invention and elastomeric films formed therefrom can be useful for making any elastomeric film component of disposable hygiene articles.

[00079] Non-limiting examples of disposable hygiene articles include baby care products such as disposable diapers, adult incontinence care products such as disposable undergarments, and feminine care products such as disposable sanitary pads.

[00080] Non-limiting examples of elastomeric film components of disposable hygiene articles include pull tabs, side tabs, side panels, waistbands, laminate layers, chassis elements, and the like.

[00081] Using thermoplastic elastomer compounds of the present invention and elastomeric films formed therefrom, which are based on a polyolefin elastomer blend rather than styrene-isoprene-styrene (SIS) block copolymers, it is possible to provide a “drop-in” solution that is capable of good high speed processing using incumbent manufacturing equipment and processes designed or adapted specifically for using SIS-based elastomeric films to make disposable hygiene articles.

[00082] Furthermore, thermoplastic elastomer compounds of the present invention and elastomeric films made therefrom possess properties, such as good softness, very high elasticity, good tensile strength, low hysteresis, low stress-relaxation, and desirable levels of tension at various levels of extension, which are desirable for various components of disposable hygiene articles.

[00083] Additionally, thermoplastic elastomer compounds of the present invention and elastomeric films made therefrom can be at least cost-competitive with conventional elastomeric films such as SIS-based elastomeric films.

[00084] Some aspects of the present invention are directed to elastomeric films formed from thermoplastic elastomer compounds as described herein.

[00085] In some embodiments, elastomeric films are monolayer films formed from thermoplastic elastomer compounds as described herein. In other embodiments, elastomeric films are incorporated into laminate structures or formed into multilayer films, such as coextruded films, including at least one layer formed from thermoplastic elastomer compounds as described herein and at least one other layer formed from a different material, for example, a polyolefin-based material.

[00086] Other aspects of the present invention are directed to disposable hygiene articles including elastomeric films formed from thermoplastic elastomer compounds as described herein.

[00087] In some embodiments, disposable hygiene articles are selected from baby care products such as disposable diapers, adult incontinence care products such as disposable undergarments, and feminine care products such as disposable sanitary pads.

EXAMPLES

[00088] Non-limiting examples of thermoplastic elastomer compounds of various embodiments of the present invention are provided.

[00089] Table 2 below shows sources of ingredients for the thermoplastic elastomer compounds of the Comparative Examples and the Examples.

Table 2

Ingredient Description	**Brand**	**Source**
Polyolefin elastomer	VISTAMAXX 3020	ExxonMobil Chemical
Polyolefin elastomer	VISTAMAXX 6102	ExxonMobil Chemical
Polyolefin elastomer	VISTAMAXX 6202	ExxonMobil Chemical
Polyolefin elastomer	VISTAMAXX 6502	ExxonMobil Chemical
SEBS block copolymer	SEPTON 8004	Kuraray
SEBS block copolymer	GLOBALPRENE 9550	LCY Chemical
SEBS block copolymer	GLOBALPRENE 9551	LCY Chemical
SEBS block copolymer	KRATON G1641	Kraton Polymers
SEBS block copolymer	KRATON G1650	Kraton Polymers
SEBS block copolymer	KRATON G1654	Kraton Polymers
Polypropylene homopolymer	PRO-FAX 6331	LyondellBasell
Polypropylene homopolymer	PRO-FAX PD702	LyondellBasell
White mineral oil	380 USP White Oil	(multiple)
White mineral oil	PURETOL 550 Oil	Petro-Canada
Antioxidant	IRGANOX 1010	BASF
Antioxidant	IRGAFOS 168	BASF

[00090] Examples of the thermoplastic elastomer compound were compounded and extruded as pellets on a twin screw extruder at typical mixing and extruding conditions. Subsequently, the extruded pellets were formed into plaques or films and then evaluated for the reported properties.

[00091] Table 3 below shows the formulations and certain properties of Comparative Examples A to C.

Table 3						
Example	**A**		**B**		**C**	
Ingredient	**Wt. Parts**	**Wt. %**	**Wt. Parts**	**Wt. %**	**Wt. Parts**	**Wt. %**
SEPTON 8004	43.50	43.50	-	-	-	-
GLOBALPRENE 9550	-	-	-	-	10.00	10.00
GLOBALPRENE 9551	-	-	36.00	36.00	26.00	26.00
380 USP White Oil	31.50	31.50	20.00	20.00	20.00	20.00
VISTAMAXX 6102	19.00	19.00	5.60	5.60	5.60	5.60
VISTAMAXX 3020	5.60	5.60	10.00	10.00	10.00	10.00
VISTAMAXX 6502	-	-	28.00	28.00	28.00	28.00
IRGANOX 1010	0.20	0.20	0.20	0.20	0.20	0.20
IRGAFOS 168	0.20	0.20	0.20	0.20	0.20	0.20
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00
Properties						
Good High Speed Processing	No		No		No	
Melt Flow Rate (230 °C, 2.16 kg) (g / 10 min) (ASTM D1238)	4.50		4.20		3.50	
Melt Flow Rate (190 °C, 2.16 kg) (g / 10 min) (ASTM D1238)	0.75		2.00		1.73	
Hardness (Shore A) (ASTM D2240)	41.9		48.0		51.5	
Tensile Strength (psi) (ASTM D638)	841.6		1016.4		1058.8	
Tensile Elongation (%) (ASTM D638)	794.7		745.4		749.9	

[00092] Table 4 below shows the formulations and certain properties of Comparative Examples D to G.

Table 4

Example	**D**		**E**		**F**	
Ingredient	**Wt. Parts**	**Wt. %**	**Wt. Parts**	**Wt. %**	**Wt. Parts**	**Wt. %**
GLOBALPRENE 9550	27.00	27.00	32.00	32.00	20.00	20.00
GLOBALPRENE 9551	-	-	9.00	9.00	-	-
PROFAX 6331	-	-	-	-	12.00	12.00
PROFAX PD702	-	-	-	-	-	-
380 USP White Oil	36.00	36.00	36.00	36.00	36.00	36.00
VISTAMAXX 6102	6.00	6.00	6.00	6.00	5.00	5.00
VISTAMAXX 3020	7.00	7.00	7.00	7.00	-	-
VISTAMAXX 6502	9.60	9.60	9.60	9.60	5.60	5.60
KRATON 1654	12.00	12.00	-	-	15.00	15.00
KRATON 1641	2.00	2.00	-	-	6.00	6.00
IRGANOX 1010	0.20	0.20	0.20	0.20	0.20	0.20
IRGAFOS 168	0.20	0.20	0.20	0.20	0.20	0.20
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00
Properties						
Good High Speed Processing	No		No		No	
Melt Flow Rate (230 °C, 2.16 kg) (g / 10 min) (ASTM D1238)	2.80		4.5		1.5	
Melt Flow Rate (190 °C, 2.16 kg) (g / 10 min) (ASTM D1238)	0.60		0.97		0.37	
Hardness (Shore A) (ASTM D2240)	(not reported)		(not reported)		(not reported)	
Tensile Strength (psi) (ASTM D638)	(not reported)		(not reported)		(not reported)	
Tensile Elongation (%) (ASTM D638)	(not reported)		(not reported)		(not reported)	

Table 4 (cont.)		
Example	**G**	
Ingredient	**Wt. Parts**	**Wt. %**
GLOBALPRENE 9550	15.00	15.00
GLOBALPRENE 9551	-	-
PROFAX 6331	-	-
PROFAX PD702	12.00	12.00
380 USP White Oil	36.00	36.00
VISTAMAXX 6102	10.60	10.60
VISTAMAXX 3020	-	-
VISTAMAXX 6502	5.00	5.00
KRATON 1654	15.00	15.00
KRATON 1641	6.00	6.00
IRGANOX 1010	0.20	0.20
IRGAFOS 168	0.20	0.20
TOTAL	100.00	100.00
Properties		
Good High Speed Processing	No	
Melt Flow Rate (230 °C, 2.16 kg) (g / 10 min) (ASTM D1238)	2.47	
Melt Flow Rate (190 °C, 2.16 kg) (g / 10 min) (ASTM D1238)	0.82	
Hardness (Shore A) (ASTM D2240)	(not reported)	
Tensile Strength (psi) (ASTM D638)	(not reported)	
Tensile Elongation (%) (ASTM D638)	(not reported)	

[00093] Table 5 below shows the formulations and certain properties of Examples 1 to 3.

Table 5						
Example	**1**		**2**		**3**	
Ingredient	**Wt. Parts**	**Wt. %**	**Wt. Parts**	**Wt. %**	**Wt. Parts**	**Wt. %**
GLOBALPRENE 9550	32.00	32.00	32.00	32.00	30.00	30.00
GLOBALPRENE 9551	7.00	7.00	9.00	9.00	10.00	10.00
380 USP White Oil	36.00	36.00	-	-	37.60	37.60
PURETOL 550 Oil	-	-	36.00	36.00	-	-
VISTAMAXX 6102	15.00	15.00	6.00	6.00	5.00	5.00
VISTAMAXX 3020	5.00	5.00	7.00	7.00	8.00	8.00
VISTAMAXX 6502	4.60	4.60	9.60	9.60	9.00	9.00
IRGANOX 1010	0.20	0.20	0.20	0.20	0.20	0.20
IRGAFOS 168	0.20	0.20	0.20	0.20	0.20	0.20
TOTAL	100.00	100.00	100.00	100.00	100.00	100.00
Properties						
Good High Speed Processing	Yes		Yes		Yes	
Melt Flow Rate (230 °C, 2.16 kg) (g / 10 min) (ASTM D1238)	7.20		6.00		6.70	
Melt Flow Rate (190 °C, 2.16 kg) (g / 10 min) (ASTM D1238)	1.50		1.15		1.63	
Hardness (Shore A) (ASTM D2240)	35.1		37.3		36.2	
Tensile Strength (psi) (ASTM D638)	653		755		727	
Tensile Elongation (%) (ASTM D638)	839		796		782	

[00094] Table 6 below shows the formulations and certain properties of Examples 4 to 9.

Table 6						
Example	**4**		**5**		**6**	
Ingredient	**Wt. Parts**	**Wt. %**	**Wt. Parts**	**Wt. %**	**Wt. Parts**	**Wt. %**
GLOBALPRENE 9550	13.05	13.01	17.40	17.36	13.05	13.01
380 USP White Oil	9.45	9.42	12.60	12.57	9.45	9.42
VISTAMAXX 6202	35.70	35.59	-	-	16.70	16.65
VISTAMAXX 6102	35.80	35.69	43.60	43.50	40.00	39.88
VISTAMAXX 6502	4.20	4.19	24.00	23.94	19.00	18.94
VISTAMAXX 3020	1.70	1.69	2.24	2.23	1.70	1.69
IRGANOX 1010	0.20	0.20	0.20	0.20	0.20	0.20
IRGAFOS 168	0.20	0.20	0.20	0.20	0.20	0.20
TOTAL	100.30	100.00	100.24	100.00	100.30	100.00
Properties						
Good High Speed Processing	Yes		Yes		Yes	
Melt Flow Rate (230 °C, 2.16 kg) (g / 10 min) (ASTM D1238)	6.3		5		6.5	
Melt Flow Rate (190 °C, 2.16 kg) (g / 10 min) (ASTM D1238)	2.9		2.5		3.4	
Hardness (Shore A) (ASTM D2240)	(not reported)		(not reported)		(not reported)	
Tensile Strength (psi) (ASTM D638)	(not reported)		(not reported)		(not reported)	
Tensile Elongation (%) (ASTM D638)	(not reported)		(not reported)		(not reported)	

Table 6 (cont.)

Example	7		8		9	
Ingredient	**Wt. Parts**	**Wt. %**	**Wt. Parts**	**Wt. %**	**Wt. Parts**	**Wt. %**
GLOBALPRENE 9550	13.05	13.01	13.05	13.01	13.05	13.02
380 USP White Oil	9.45	9.42	9.45	9.42	9.45	9.43
VISTAMAXX 6202	16.70	16.65	21.00	20.94	-	-
VISTAMAXX 6102	40.00	39.88	40.70	40.58	23.20	23.14
VISTAMAXX 6502	19.00	18.94	14.00	13.96	35.00	34.91
VISTAMAXX 3020	1.70	1.69	1.70	1.69	19.15	19.10
IRGANOX 1010	0.20	0.20	0.20	0.20	0.20	0.20
IRGAFOS 168	0.20	0.20	0.20	0.20	0.20	0.20
TOTAL	100.30	100.00	100.30	100.00	100.25	100.00
Properties						
Good High Speed Processing	Yes		Yes		Yes	
Melt Flow Rate (230 °C, 2.16 kg) (g / 10 min) (ASTM D1238)	6.6		6.6		7.6	
Melt Flow Rate (190 °C, 2.16 kg) (g / 10 min) (ASTM D1238)	3.1		2.87		3.6	
Hardness (Shore A) (ASTM D2240)	(not reported)		(not reported)		(not reported)	
Tensile Strength (psi) (ASTM D638)	(not reported)		(not reported)		(not reported)	
Tensile Elongation (%) (ASTM D638)	(not reported)		(not reported)		(not reported)	

[00095] Table 7 below shows the formulations and certain properties of Examples 10 to 14.

Table 7						
Example	**10**		**11**		**12**	
Ingredient	**Wt. Parts**	**Wt. %**	**Wt. Parts**	**Wt. %**	**Wt. Parts**	**Wt. %**
KRATON G1650	13.05	13.01	13.05	13.01	26.10	26.06
380 USP White Oil	9.45	9.42	9.45	9.42	18.90	18.87
VISTAMAXX 6202	17.00	16.95	28.70	28.61	-	-
VISTAMAXX 6102	35.70	35.60	34.80	34.70	51.40	51.32
VISTAMAXX 6502	23.00	22.93	1220	12.16	-	-
VISTAMAXX 3020	1.70	1.69	1.70	1.69	3.36	3.35
IRGANOX 1010	0.20	0.20	0.20	0.20	0.20	0.20
IRGAFOS 168	0.20	0.20	0.20	0.20	0.20	0.20
TOTAL	100.30	100.00	100.30	100.00	100.16	100.00
Properties						
Good High Speed Processing	Yes		Yes		Yes	
Melt Flow Rate (230 °C, 2.16 kg) (g / 10 min) (ASTM D1238)	9.8		9.59		5.62	
Melt Flow Rate (190 °C, 2.16 kg) (g / 10 min) (ASTM D1238)	4.25		4.10		1.65	
Hardness (Shore A) (ASTM D2240)	59.0		(not reported)		50.4	
Tensile Strength (psi) (ASTM D638)	1180		(not reported)		994	
Tensile Elongation (%) (ASTM D638)	950		(not reported)		926	

Table 7 (cont.)

Example	**13**		**14**	
Ingredient	**Wt. Parts**	**Wt. %**	**Wt. Parts**	**Wt. %**
KRATON G1650	21.75	21.71	17.40	17.36
380 USP White Oil	15.75	15.72	12.60	12.57
VISTAMAXX 6202	-	-	-	-
VISTAMAXX 6102	59.50	59.38	67.60	67.44
VISTAMAXX 6502	-	-	-	-
VISTAMAXX 3020	2.80	2.79	2.24	2.23
MB3150	-	-	-	-
SCLAIR 2908	-	-	-	-
IRGANOX 1010	0.20	0.20	0.20	0.20
IRGAFOS 168	0.20	0.20	0.20	0.20
TOTAL	100.20	100.00	100.24	100.00
Properties				
Good High Speed Processing	Yes		Yes	
Melt Flow Rate (230 °C, 2.16 kg) (g / 10 min) (ASTM D1238)	5.38		5.66	
Melt Flow Rate (190 °C, 2.16 kg) (g / 10 min) (ASTM D1238)	1.77		2.19	
Hardness (Shore A) (ASTM D2240)	52.2		(not reported)	
Tensile Strength (psi) (ASTM D638)	1139		(not reported)	
Tensile Elongation (%) (ASTM D638)	925		(not reported)	

[00096] Without undue experimentation, those having ordinary skill in the art can utilize the written description of the present invention, including the Examples, to formulate thermoplastic elastomer compounds and make elastomeric films which are based on polyolefin elastomer blends rather than styrene-isoprene-styrene (SIS) block copolymers but which are compatible with manufacturing equipment and processes designed or adapted specifically for SIS-based elastomeric films, while possessing properties desirable for making disposable hygiene articles and while also being relatively low cost.

[00097] All documents cited in the Embodiments of the Invention are incorporated herein by reference in their entirety unless otherwise specified. The citation of any document is not to be construed as an admission that it is prior art with respect to the present invention.

[00098] While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of the present invention.

WHAT IS CLAIMED IS:

1. A thermoplastic elastomer compound comprising:

    (a) a polyolefin elastomer blend comprising:

        (i) a first polyolefin elastomer; and

        (ii) a second polyolefin elastomer different from the first polyolefin elastomer;

    (b) styrene-ethylene/butylene-styrene block copolymer; and

    (c) plasticizer;

wherein the compound has a Melt Flow Rate (230 °C, 2.16 kg) of no less than about 5 g / 10 min and a Melt Flow Rate (190 °C, 2.16 kg) of no less than about 1 g / 10 min.

2. The compound of Claim 1, wherein the compound has a Melt Flow Rate (230 °C, 2.16 kg) of no less than about 6 g / 10 min.

3. The compound of Claim 1 or Claim 2, wherein the compound has a Melt Flow Rate (190 °C, 2.16 kg) of no less than about 1.5 g / 10 min.

4. The compound of any one of Claims 1 to 3, wherein the compound has a Melt Flow Rate (230 °C, 2.16 kg) from about 6 to about 15 g / 10 min.

5. The compound of any one of Claims 1 to 4, wherein the compound has a Melt Flow Rate (190 °C, 2.16 kg) from about 1.5 to about 10 g / 10 min.

6. The compound of any one of Claims 1 to 5, wherein the polyolefin elastomer blend further comprises a third polyolefin elastomer different from each of the first polyolefin elastomer and the second polyolefin elastomer.

7. The compound of Claim 6, wherein the polyolefin elastomer blend further comprises a fourth polyolefin elastomer different from each of the first polyolefin elastomer, the second polyolefin elastomer, and the third polyolefin polymer.

8. The compound of any one of Claims 1 to 7, wherein one or more of the polyolefin elastomers of the polyolefin elastomer blend is selected from the group consisting of propylene-based elastomer, ethylene/α-olefin random copolymer, and combinations thereof.

9. The compound of any one of Claims 1 to 8, wherein one or more of the polyolefin elastomers of the polyolefin elastomer blend is selected from propylene-based elastomer comprising (a) at least about 60 weight percent of propylene-derived units, (b) at least about 6 weight percent of ethylene-derived units, and (c) from about 0.3 to about 10 weight percent of diene-derived units, based on a combined weight of the propylene-derived units, the ethylene-derived units, and the diene-derived units.

10. The compound of any one of Claims 1 to 9, wherein one or more of the polyolefin elastomers of the polyolefin elastomer blend is selected from the group consisting of:

(a) propylene-based elastomer comprising about 13 weight percent of ethylene-derived units and having a Melt Flow Rate (190 °C, 2.16 kg) of about 21 g / 10 min and a Shore A hardness of about 71 according to ASTM D2240;

(b) propylene-based elastomer comprising about 15 weight percent of ethylene-derived units and having a Melt Flow Rate (190 °C, 2.16 kg) of about 9.1 g / 10 min and a Shore A hardness of about 66 according to ASTM D2240;

(c) propylene-based elastomer comprising about 16 weight percent of ethylene-derived units and having a Melt Flow Rate (190 °C, 2.16 kg) of about 1.4 g / 10 min and a Shore A hardness of about 66 according to ASTM D2240; and

(d) propylene-based elastomer comprising about 11 weight percent of ethylene-derived units and having a Melt Flow Rate (190 °C, 2.16 kg) of about 1.1 g / 10 min and a Shore D hardness of about 34 according to ASTM D2240.

11. The compound of any one of Claims 1 to 10, wherein the compound further comprises one or more additives selected from the group consisting of antioxidants and stabilizers; bonding agents; colorants; impact modifiers; non-elastomeric thermoplastic polymers; tackifiers; ultraviolet light absorbers; waxes; and combinations thereof.

12. The compound of Claim 11, wherein the non-elastomeric thermoplastic polymer is selected from non-elastomeric polyolefin polymers, non-elastomeric polystyrene polymers, and combinations thereof.

13. The compound of any one of Claims 1 to 12, wherein the compound comprises:

(a) from about 20 to about 85 weight percent, by weight of the compound, of the polyolefin elastomer blend;

(b) from about 10 to about 50 weight percent, by weight of the compound, of the styrene-ethylene/butylene-styrene block copolymer;

(c) from about 5 to about 40 weight percent, by weight of the compound, of the plasticizer; and

(d) from 0 to about 12 weight percent, by weight of the compound, of one or more additives selected from the group consisting of antioxidants and stabilizers, bonding agents, colorants, impact modifiers, non-elastomeric thermoplastic polymers, tackifiers, ultraviolet light absorbers, waxes, and combinations thereof.

14. The compound of any one of Claims 1 to 13, wherein the compound is free of styrene-isoprene-styrene block copolymer.

15. An elastomeric film formed from the compound of any one of Claims 1 to 14.

16. A multilayer film or laminate structure comprising at least one layer formed the compound of any one of Claims 1 to 14.

17. A disposable hygiene article comprising at least one component comprising an elastomeric film formed from the compound of any one of Claims 1 to 14.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2018/059938

A. CLASSIFICATION OF SUBJECT MATTER

C08L 23/16(2006.01)i, C08L 53/00(2006.01)i, C08L 25/06(2006.01)i, E21B 33/12(2006.01)i

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)
C08L 23/16; C08F 297/04; C08L 23/00; C08L 23/02; C08L 23/26; C08L 25/04; C08L 25/08; C08L 53/02; C08L 53/00; C08L 25/06; E21B 33/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords:thermoplastic, elastomer, polypropylene, olefin, SEBS, plasticizer

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2016-0060443 A1 (MITSUI CHEMICALS, INC.) 03 March 2016 See paragraphs [0248]-[0388], [1034]-[1049]; tables 1-1. 1-2; claim 1.	1-3
X	US 2011-0281994 A1 (EGUCHI YUTAKA et al.) 17 November 2011 See paragraphs [0018]-[0071], [0102]-[0125]; table 1.	1-3
A	US 2015-0175793 A1 (KIMBERLY-CLARK WORLDWIDE, INC.) 25 June 2015 See paragraphs [0032]-[0050].	1-3
A	JP 2008-247945 A (SUMITOMO CHEMICAL CO., LTD.) 16 October 2008 See the whole document.	1-3
A	KR 10-1672665 B1 (KURARAY CO., LTD. et al.) 03 November 2016 See the whole document.	1-3

☐ 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
12 April 2019 (12.04.2019)

Date of mailing of the international search report
15 April 2019 (15.04.2019)

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea
Facsimile No. +82-42-481-8578

Authorized officer
KWON, YONGKYONG
Telephone No. +82-42-481-3371

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2018/059938

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 7,12
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Claims 7, 12 each refer to one of claims which are not drafted in accordance with PCT Rule 6.4(a).

3. ☒ Claims Nos.: 4-6,8-11,13-17
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required addtional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of any additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
☐ No protest accompanied the payment of additional search fees.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2016-0060443 A1	03/03/2016	AT 547468 T	15/03/2012
		AT 552301 T	15/04/2012
		CN 101065438 A	31/10/2007
		CN 101065438 B	06/06/2012
		CN 102627803 A	08/08/2012
		CN 102627803 B	06/08/2014
		CN 104045912 A	17/09/2014
		CN 104045912 B	23/06/2017
		CN 104085160 A	08/10/2014
		CN 104085160 B	24/08/2018
		CN 104086900 A	08/10/2014
		CN 104086900 B	26/10/2016
		CN 104086901 A	08/10/2014
		CN 104086901 B	06/04/2016
		EP 1820821 A1	22/08/2007
		EP 1820821 A4	08/07/2009
		EP 1820821 B1	29/02/2012
		EP 2246390 A1	03/11/2010
		EP 2246390 B1	26/12/2012
		EP 2248848 A1	10/11/2010
		EP 2248848 B1	15/07/2015
		EP 2248852 A1	10/11/2010
		EP 2248852 B1	04/04/2012
		EP 2248852 B8	16/05/2012
		EP 2402392 A1	04/01/2012
		EP 2402392 B1	18/09/2013
		EP 2402393 A1	04/01/2012
		EP 2402393 B1	28/08/2013
		JP 2012-229442 A	22/11/2012
		JP 2012-229443 A	22/11/2012
		JP 2012-229444 A	22/11/2012
		JP 2012-229445 A	22/11/2012
		JP 2013-007045 A	10/01/2013
		JP 2013-010960 A	17/01/2013
		JP 2013-234334 A	21/11/2013
		JP 2013-256670 A	26/12/2013
		JP 5291291 B2	18/09/2013
		JP 5296907 B2	25/09/2013
		JP 5543550 B2	09/07/2014
		JP 5543551 B2	09/07/2014
		JP 5543552 B2	09/07/2014
		JP 5543553 B2	09/07/2014
		JP 5602805 B2	08/10/2014
		JP 5657757 B2	21/01/2015
		JP 5828872 B2	09/12/2015
		KR 10-0886444 B1	04/03/2009
		KR 10-0920710 B1	09/10/2009
		KR 10-0937693 B1	20/01/2010
		KR 10-2007-0084308 A	24/08/2007

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		KR 10-2008-0043373 A	16/05/2008
		KR 10-2008-0104050 A	28/11/2008
		KR 10-2009-0032146 A	31/03/2009
		TW 200643086 A	16/12/2006
		TW I325875 A	11/06/2010
		TW I325875 B	11/06/2010
		US 2007-0251572 A1	01/11/2007
		US 2013-0011596 A1	10/01/2013
		US 2013-0011649 A1	10/01/2013
		US 2013-0017351 A1	17/01/2013
		US 2013-0017379 A1	17/01/2013
		US 2016-0060407 A1	03/03/2016
		US 2016-0122492 A1	05/05/2016
		US 8338697 B2	25/12/2012
		US 8592674 B2	26/11/2013
		US 8946543 B2	03/02/2015
		US 8962974 B2	24/02/2015
		US 9217078 B2	22/12/2015
		US 9908983 B2	06/03/2018
		US 9963567 B2	08/05/2018
		US 9969853 B2	15/05/2018
		WO 2006-057361 A1	05/06/2008
US 2011-0281994 A1	17/11/2011	CN 102245697 A	16/11/2011
		CN 102245697 B	07/08/2013
		EP 2365031 A1	14/09/2011
		EP 2365031 A4	02/05/2012
		EP 2365031 B1	08/02/2017
		ES 2618779 T3	22/06/2017
		JP 5681491 B2	11/03/2015
		TW 201026765 A	16/07/2010
		TW I445752 B	21/07/2014
		US 8722799 B2	13/05/2014
		WO 2010-067564 A1	17/06/2010
US 2015-0175793 A1	25/06/2015	AU 2014-369322 A1	25/06/2015
		AU 2014-369322 A1	21/07/2016
		AU 2014-369322 B2	30/11/2017
		AU 2014-375035 A1	21/07/2016
		AU 2014-375035 A1	09/07/2015
		AU 2014-375035 B2	08/03/2018
		AU 2015-242310 A1	08/10/2015
		AU 2015-242310 A1	27/10/2016
		AU 2015-242310 B2	14/06/2018
		AU 2015-348023 A1	23/03/2017
		AU 2015-348023 A1	26/05/2016
		AU 2015-348023 B2	08/11/2018
		BR 112017003009 A2	12/12/2017
		CN 105814121 A	27/07/2016
		CN 105814121 B	10/08/2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		CN 105829098 A	03/08/2016
		CN 105829098 B	16/10/2018
		CN 106103088 A	09/11/2016
		CN 106660307 A	10/05/2017
		EP 3083781 A1	26/10/2016
		EP 3083781 A4	10/05/2017
		EP 3089872 A1	09/11/2016
		EP 3089872 A4	27/08/2017
		EP 3126140 A1	08/02/2017
		EP 3126140 A4	27/12/2017
		EP 3188904 A1	12/07/2017
		EP 3188904 A4	11/04/2018
		KR 10-1783574 B1	29/09/2017
		KR 10-1814353 B1	30/01/2018
		KR 10-2016-0095180 A	10/08/2016
		KR 10-2016-0101968 A	26/08/2016
		KR 10-2016-0140741 A	07/12/2016
		KR 10-2017-0036804 A	03/04/2017
		MX 2016007362 A	19/08/2016
		MX 2016008493 A	13/09/2016
		MX 2016012442 A	20/12/2016
		MX 2017002074 A	04/05/2017
		MX 347416 B	26/04/2017
		MX 360519 B	05/11/2018
		RU 2016140366 A	13/04/2018
		RU 2609797 C1	06/02/2017
		RU 2630146 C1	05/09/2017
		RU 2641332 C1	17/01/2018
		RU 2661214 C2	13/07/2018
		RU 2674414 C1	07/12/2018
		US 0213990 B2	26/02/2019
		US 2015-0174869 A1	25/06/2015
		US 2015-0183191 A1	02/07/2015
		US 2015-0273802 A1	01/10/2015
		US 9358759 B2	07/06/2016
		US 9428638 B2	30/08/2016
		US 9802392 B2	31/10/2017
		WO 2015-092615 A1	25/06/2015
		WO 2015-101852 A1	09/07/2015
		WO 2015-150937 A1	08/10/2015
		WO 2016-079608 A1	26/05/2016
JP 2008-247945 A	16/10/2008	None	
KR 10-1672665 B1	03/11/2016	CA 2910534 A1	02/04/2015
		CA 2910534 C	01/11/2016
		CN 105246971 A	13/01/2016
		CN 105246971 B	30/03/2018
		EP 2980153 A1	03/02/2016
		EP 2980153 A4	27/04/2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		EP 2980153 B1	08/03/2017
		ES 2620090 T3	27/06/2017
		JP 5763865 B1	12/08/2015
		KR 10-2015-0126733 A	12/11/2015
		TW 201522480 A	16/06/2015
		TW I535774 B	01/06/2016
		US 2016-0108228 A1	21/04/2016
		US 9752027 B2	05/09/2017
		WO 2015-046524 A1	02/04/2015