SUMMARY

[005a] In a first aspect of the present disclosure, there is provided a biodegradable polymeric composition comprising: (1) from 5 weight percent to 95 weight percent poly(hydroxyalkanoates); (2) from 5 weight percent to 95 weight percent of at least one biodegradable polymer selected from the group consisting of poly(butylene succinate), poly(butylene succinate-co-adipate), poly(butylene adipate-co-terephthalate, poly(caprolactone), poly(lactic acid), cellulose esters, thermoplastic starch, and mixtures thereof; and (3) from 0.1 weight percent to 5 weight percent of a nucleating agent; wherein the poly(hydroxyalkanoates) comprise a mixture of a first copolymer and a second copolymer, wherein the first copolymer comprises from 90 to 99.9 mole percent monomer residues of 3-hydroxybutyrate and from 0.1 to 10 mole percent monomer residues of a second 3-hydoxyalkanoate having from 5 to 12 carbon atoms and wherein the second copolymer comprises at least 70 mole percent monomer residues of 3-hydroxybutyrate and monomer residues of the second 3-hydoxyalkanoate having from 5 to 12 carbon atoms in amount which at least 6 mole percent less than the amount of the second 3-hydoxyalkanoate in the first polymer; wherein the term biodegradable refers to a plastic or polymeric material that will undergo biodegradation by living organisms (microbes) in anaerobic and aerobic environments, as determined by ASTM D5511, in soil environments, as determined by ASTM 5988, in freshwater environments, as determined by ASTM D5271, or in marine environments, as determined by ASTM D6691.

[005b] In another aspect of the present disclosure, there is provided a product package for a consumer goods product, wherein the product package comprises at least one biodegradable package portion which comprises the polymeric composition as disclosed herein; wherein the term biodegradable refers to a plastic or polymeric material that will undergo biodegradation by living organisms (microbes) in anaerobic and aerobic environments, as determined by ASTM D5511, in soil environments, as determined by ASTM 5988, in freshwater environments, as determined by ASTM D5271, or in marine environments, as determined by ASTM D6691.

[006] In one example, the present disclosure provides a biodegradable polymeric composition. In one example, this polymeric composition includes at least (1) from about 5 weight percent to about 95 weight percent poly(hydroxyalkanoates); (2) from about 5 weight percent to about 95 weight percent of at least one biodegradable polymer selected from the group consisting of poly(butylene succinate), poly(butylene succinate-co-adipate), poly(butylene adipate-co-terephthalate, poly(caprolactone), poly(lactic acid), cellulose esters (such as cellulose acetate) thermoplastic starch, and mixtures thereof; and (3) from about 0.1 weight percent to about 5 weight percent of a nucleating agent,.

[007] In certain examples, the polymeric composition preferably includes from about 35 weight percent to about 90 weight percent poly(hydroxyalkanoates). More preferably, the polymeric composition includes from about 40 weight percent to about 70 weight percent poly(hydroxyalkanoates)

[008] In some examples, the polymeric composition preferably includes from about 5 weight percent to about 50 weight percent poly(butylene succinate). More preferably, the polymeric composition includes from about 10 weight percent to about 30 weight percent poly(butylene succinate).

[009] According to some examples, the polymeric composition preferably includes from about 5 weight percent to about 50 weight percent poly(butylene succinate-co-adipate).

WHAT IS CLAIMED IS

Claim 1. A biodegradable polymeric composition comprising: (1) from 5 weight percent to 95 weight percent poly(hydroxyalkanoates); (2) from 5 weight percent to 95 weight percent of at least one biodegradable polymer selected from the group consisting of poly(butylene succinate), poly(butylene succinate-co-adipate), poly(butylene adipate-co-terephthalate, poly(caprolactone), poly(lactic acid), cellulose esters, thermoplastic starch, and mixtures thereof; and (3) from 0.1 weight percent to 5 weight percent of a nucleating agent;

wherein the poly(hydroxyalkanoates) comprise a mixture of a first copolymer and a second copolymer,

wherein the first copolymer comprises from 90 to 99.9 mole percent monomer residues of 3-hydroxybutyrate and from 0.1 to 10 mole percent monomer residues of a second 3-hydoxyalkanoate having from 5 to 12 carbon atoms and

wherein the second copolymer comprises at least 70 mole percent monomer residues of 3-hydroxybutyrate and monomer residues of the second 3-hydoxyalkanoate having from 5 to 12 carbon atoms in amount which at least 6 mole percent less than the amount of the second 3-hydoxyalkanoate in the first polymer;

wherein the term biodegradable refers to a plastic or polymeric material that will undergo biodegradation by living organisms (microbes) in anaerobic and aerobic environments, as determined by ASTM D5511, in soil environments, as determined by ASTM 5988, in freshwater environments, as determined by ASTM D5271, or in marine environments, as determined by ASTM D6691.

Claim 2. The polymeric composition of Claim 1, wherein the composition comprises from 35 weight percent to 90 weight percent poly(hydroxyalkanoates).

Claim 3. The polymeric composition of Claim 1, wherein the composition comprises from 30 weight percent to 90 weight percent poly(butylene succinate) or from 30 weight percent to 90 weight percent poly(butylene succinate-co-adipate).

Claim 4. The polymeric composition of Claim 1, wherein the composition comprises from 10 weight percent to 70 weight percent poly(lactic acid).

Claim 5. The polymeric composition of Claim 1, wherein the composition comprises from 30 weight percent to 90 weight percent cellulose esters.

Claim 6. The polymeric composition of Claim 1, wherein the nucleating agent is selected from the group consisting of erythritols, pentaerythritol, dipentaerythritols, artificial sweeteners, stearates, polysaccharides, sorbitols, mannitols, inositols, polyester waxes, nanoclays, behenamide, erucamide, stearamide, oleamide, poly(hydroxybutyrate), thymine, cyanuric acid, cytosine, adenine, uracil, guanine, boron nitride and mixtures thereof.

Claim 7. The polymeric composition of Claim 1, wherein the composition further comprises up to 15 weight percent of a plasticizer selected from the group consisting of sebacates, citrates, fatty esters of adipic, succinic, and glucaric acids, lactates, alkyl diesters, citrates, alkyl methyl esters, dibenzoates, propylene carbonate, esters of vegetable oils, long chain alkyl acids, adipates, glycerol, isosorbide derivatives or mixtures thereof, polymeric plasticizers, poly(hydroxyalkanoates) copolymers comprising at least 18 mole percent monomer residues of hydroxyalkanoates other than hydroxybutyrate, and mixtures thereof.

Claim 8. The polymeric composition of Claim 7, wherein the composition comprises from 5 weight percent to 15 weight percent of the plasticizer.

Claim 9. The polymeric composition of Claim 1, wherein the composition further comprises up to 20 weight percent of an impact modifier selected from the group consisting of group consisting of acrylic-based resins and emulsions, isosorbide derivatives, natural rubbers, aliphatic polyesters, or mixtures thereof.

Claim 10. The polymeric composition of Claim 9, wherein the composition comprises from 5 weight percent to 15 weight percent of the impact modifier.

Claim 11. The polymeric composition of Claim 1, wherein the composition further comprises up to 50 weight percent of one or more additives selected from the group consisting of poly(vinyl alcohols), poly(vinyl acetate), poly(vinyl laurate), poly(ethylene vinyl acetate), poly(glycolic acid), furandicarboxylic acid-based polyesters, cellulose, nanocellulose, glucans, and mixtures thereof.

Claim 12. The polymeric composition of Claim 1, wherein the poly(hydroxyalkanoates) and the at least one biodegradable polymer are transesterified with one another.

Claim 13. The polymeric composition of Claim 1, wherein the poly(hydroxyalkanoates) and the at least one biodegradable polymer are reactively extrusion with one another.

Claim 14. A product package for a consumer goods product, wherein the product package comprises at least one biodegradable package portion which comprises the polymeric composition of Claim 1;

wherein the term biodegradable refers to a plastic or polymeric material that will undergo biodegradation by living organisms (microbes) in anaerobic and aerobic environments, as determined by ASTM D5511, in soil environments, as determined by ASTM 5988, in freshwater environments, as determined by ASTM D5271, or in marine environments, as determined by ASTM D6691.

Claim 15. The product package of Claim 14, wherein the at least biodegradable package portion is formed by a method selected from the group consisting of injection molding, compression molding, thermoforming, cast and blown film formation, extrusion coating, extrusion blow molding, injection stretch blow molding, and extrusion profiling.