SUMMARY

[005a] In one aspect, the present disclosure refers to a biodegradable aqueous dispersion for coating food contact substrates, the dispersion comprising:

from about 35 to about 75 weight percent water;

from about 25 to about 65 weight percent of polyhydroxyalkanoates;

from about 0.01 weight percent to about 5.0 weight percent of at least one surfactant;

from about 0.01 weight percent to about 5.0 weight percent of at least one rheology modifier;

from about 0.01 weight percent to about 2.5 weight percent of at least one wetting and dispersing agent; and

from about 0.01 weight percent to about 0.5 weight percent of at least one biocide or biostatic agent.

[005b] In another aspect, the present disclosure refers to a biodegradable food service item comprising:

a biodegradable substrate having at least one food contact surface; and

a coating applied over the at least one food contact surface,

wherein the coating is applied as a biodegradable aqueous dispersion, comprising

from about 35 to about 75 weight percent water;

from about 25 to about 65 weight percent of polyhydroxyalkanoates;

from about 0.01 weight percent to about 5.0 weight percent of at least one surfactant;

from about 0.01 weight percent to about 5.0 weight percent of at least one rheology modifier;

from about 0.01 weight percent to about 2.5 weight percent of at least one wetting and dispersing agent; and

from about 0.01 weight percent to about 0.5 weight percent of at least one biocide or biostatic agent.

[006] The above and other needs are met by a biodegradable aqueous dispersion for coating food contact substrates. According to one example, this dispersion is

made up of from about 35 to about 75 weight percent water and from about 25 to about 65 weight percent of polyhydroxyalkanoates.

[007] In certain examples, the dispersion is preferably made up of from about 25 to about 65 weight percent poly-3-hydroxybutyrate-co-3-hydroxyhexanoate ("P(3HB-co-3HHx)"). Moreover, in certain examples, this P(3HB-co-3HHx) is in turn preferably made up of from about 75 to about 99 mole percent hydroxybutyrate and from about 1 to about 25 mole percent hydroxyhexanoate. More preferably, the P(3HB-co-3HHx) is made up of from about 85 to about 95 mole percent hydroxybutyrate and from about 5 to about 15 mole percent hydroxyhexanoate.

[008] In some examples, the dispersion is preferably made up of from about 1 to about 25 weight percent of at least one polyhydroxyalkanoate comprising from about 25 to about 50 mole percent of hydroxyvalerate, hydroxyhexanoate, hydroxyoctanoate, and/or hydroxydecanoate.

[009] Further, in some instances, the polyhydroxyalkanoate polymer may be a terpolymer, made up of at least three different type of hydroxyalkanoate monomer residues. The terpolymer may, for example, include from about 75 to about 99 mole percent of hydroxybutyrate, from about 0.1 to about 15 mole percent of hydroxyvalerate, and from about 1 to about 25 mole percent of a third hydroxyalkanoate, such as hydroxyhexanoate

[010] According to certain examples, the polyhydroxyalkanoates in the dispersion preferably have a weight average molecular weight from about 50,000 Daltons to about 2.5 million Daltons. More preferably, the weight average molecular weight is from about 150,000 Daltons to about 600,000 Daltons, and still more preferably from about 150,000 Daltons to about 500,000 Daltons.

[011] In certain examples, the dispersion is made up of particles preferably having an average particle size from about 10 nm to about 50 μm. Further, in some examples, the dispersion preferably has an average solids content from about 25 percent to about 65

percent solids. More preferably, the average solids content is from about 40 percent to about 55 percent solids and even more preferably from about 40 to about 50 percent solids.

[012] In addition to the water and the PHA, the dispersion may, optionally, include further components. For instance, in certain examples, the dispersion preferably also includes from about 0.01 weight percent to about 5.0 weight percent of at least one surfactant selected from the group consisting of polysorbates, aromatic polyethylene oxides, sorbitan derivatives, block copolymers of poly(ethylene oxide) and poly(propylene oxide), poly(glycol ethers), poly(vinyl alcohol), alkyl sulfates, alkyl phosphates, stearates, and mixtures thereof. More preferably, the dispersion includes from about 0.5 weight percent to about 5.0 weight percent of the at least one surfactant, and even more preferably from about 0.5 weight percent to about 2.0 weight percent of the at least one surfactant.

[013] In some instances, this at least one surfactant preferably has a hydrophilic-lipophilic balance which is greater than 10. More preferably, the at least one surfactant preferably has a hydrophilic-lipophilic balance which is from about 12 to about 15.

[014] In some examples, the dispersion preferably also includes from about 0.01 weight percent to about 5.0 weight percent of at least one rheology modifier selected from the group consisting of polysaccharides, acrylate-based emulsion copolymers, viscosity depressants, and viscosity enhancers.

[015] In some instances, the dispersion preferably also includes from about 0.01 weight percent to about 2.5 weight percent of at least one wetting and dispersing agent.

[016] According to certain examples, the dispersion preferably also includes from about 0.01 weight percent to about 0.5 weight percent of at least one biocide or biostatic agent.

[017] In certain examples, the dispersion preferably also includes from about 0.1 weight percent to about 5.0 weight percent of at least one coalescing agent selected from the group consisting of bio-succinic acid based coalescing solvent, 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate, dimethyl carbonate, methanol, ethanol, ketones, acetates, and or mixtures thereof.

[018] In some examples, the dispersion preferably also includes from about 1 weight percent to about 35 weight percent of at least one filler selected from the group consisting of clays, calcium carbonate, talc, kaolinite, montmorillonite, bentonite, silica, chitin, titanium dioxide, nano clay, mica, or mixtures thereof.

[019] In certain examples, the dispersion preferably also includes from about 0.5 weight percent to about 15 weight percent of at least one 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, caprolactone diols having a number average molecular weight from 200-10,000 g/mol, poly(ethylene) glycols having a number average molecular weight of 400-10,000 g/mol, esters of vegetable oils, long chain alkyl acids, adipates, glycerol, isosorbide derivatives or mixtures thereof.

[020] In other examples, the dispersion preferably also includes from about 0.1 weight percent to about 5 weight percent of at least one nucleating agent selected from the group consisting of sulfur, erythritols, pentaerythritol, dipentaerythritols, artificial sweeteners, stearates, sorbitols, polyester waxes, 2:1;2:1 crystal structure chemicals and mixtures thereof. (What's an example of a 2:1,2:1 crystal structure?) examples are sorbitols, mannitols, stearates, etc.

[021] According to some examples, the dispersion preferably also includes from about 0.01 weight percent to about 5 weight percent of at least one crosslinking agent selected from the group consisting of calendula oil, stabilized ammonium zirconium carbonate, anionic hydroxylated zirconium polymers, potassium zirconium carbonate, anionic hydroxylated zirconium polymers, zinc tetraamine carbonate, and mixtures thereof.

[022] In some examples, the dispersion preferably also includes from about 0.05 to about 1 weight percent of at least one defoamer selected from the group consisting of polyether siloxanes, polyamide particles and mixtures thereof.

[023] In one preferred example, the dispersion may, in addition to the water and the PHA also include: (1) from about 0.01 weight percent to about 5.0 weight percent of at least one surfactant; (2) from about 0.01 weight percent to about 5.0 weight percent of at least one rheology modifier; (3) from about 0.01 weight percent to about 2.5 weight percent

of at least one wetting and dispersing agent; and (4) from about 0.01 weight percent to about 0.5 weight percent of at least one biocide or biostatic agent.

[024] In a second example, the present disclosure provides a biodegradable food service item. According to one example, the biodegradable food service item includes a biodegradable substrate having at least one food contact surface. The food service item also includes a coating applied over the at least one food contact surface. This coating is applied as a biodegradable aqueous dispersion, which is made up of from about 35 to about 75 weight percent water and from about 25 to about 65 weight percent of polyhydroxyalkanoates.

[025] In certain examples, the biodegradable substrate is preferably a biodegradable plate, cup, bowl, fiber tray, or eating utensil.

[026] In some examples, the coating is preferably applied over the at least one food contact surface at a coating weight, on a dry basis, from about 2 to about 25 grams per square meter, and more preferably from about 4 to about 25 grams per square meter.

[027] In certain examples, the coating preferably exhibits a Cobb water absorption value, measured according to TAPPI Standard T441, of less than 20 grams per square meter. More preferably, the Cobb water absorption value is less than 10 grams per square meter. Further, in certain examples, the coating preferably exhibits a Kit Test grease resistance value, measured according to TAPPI Standard T559 cm-12, of greater than Kit Value 5. More preferably, the Kit Value is from about 8 to about 12.

WHAT IS CLAIMED IS

Claim 1. A biodegradable aqueous dispersion for coating food contact substrates, the dispersion comprising:

from about 35 to about 75 weight percent water;

from about 25 to about 65 weight percent of polyhydroxyalkanoates;

from about 0.01 weight percent to about 5.0 weight percent of at least one surfactant;

from about 0.01 weight percent to about 5.0 weight percent of at least one rheology modifier;

from about 0.01 weight percent to about 2.5 weight percent of at least one wetting and dispersing agent; and

from about 0.01 weight percent to about 0.5 weight percent of at least one biocide or biostatic agent.

Claim 2. The biodegradable aqueous dispersion of Claim 1, wherein the dispersion comprises from about 25 to about 65 weight percent poly-3-hydroxybutyrate-co-3-hydroxyhexanoate ("P(3HB-co-3HHx)").

Claim 3. The biodegradable aqueous dispersion of Claim 2, wherein the P(3HB-co-3HHx) comprises from about 75 to about 99 mole percent hydroxybutyrate and from about 1 to about 25 mole percent hydroxyhexanoate.

Claim 4. The biodegradable aqueous dispersion of Claim 1, wherein the dispersion comprises from about 1 to about 25 weight percent of at least one polyhydroxyalkanoate comprising from about 25 to about 50 mole percent of hydroxyvalerate, hydroxyhexanoate, hydroxyoctanoate, and/or hydroxydecanoate.

Claim 5. The biodegradable aqueous dispersion of Claim 1, wherein the dispersion comprises polyhydroxyalkanoates having a weight average molecular weight from about 50,000 Daltons to about 2.5 million Daltons.

Claim 6. The biodegradable aqueous dispersion of Claim 1, wherein the dispersion comprises particles having an average particle size from about 10 nm to about 50 μm.

Claim 7. The biodegradable aqueous dispersion of Claim 1, wherein the dispersion has an average solid content from about 25 percent to about 65 percent solids.

Claim 8. The biodegradable aqueous dispersion of Claim 1, wherein the dispersion further comprises from about 0.01 weight percent to about 5.0 weight percent of at least one surfactant selected from the group consisting of polysorbates, aromatic polyethylene oxides, sorbitan derivatives, block copolymers of poly(ethylene oxide) and poly(propylene oxide), poly(glycol ethers), poly(vinyl alcohol), alkyl sulfates, alkyl phosphates, stearates, and mixtures thereof.

Claim 9. The biodegradable aqueous dispersion of Claim 8, wherein the at least one surfactant has a hydrophilic-lipophilic balance which is greater than 10.

Claim 10. The biodegradable aqueous dispersion of Claim 1, wherein the dispersion further comprises from about 0.01 weight percent to about 5.0 weight percent of at least one rheology modifier selected from the group consisting of polysaccharides, acrylate-based emulsion copolymers, viscosity depressants, and viscosity enhancers.

Claim 11. A biodegradable food service item comprising:

a biodegradable substrate having at least one food contact surface; and

a coating applied over the at least one food contact surface,

wherein the coating is applied as a biodegradable aqueous dispersion, comprising

from about 35 to about 75 weight percent water;

from about 25 to about 65 weight percent of polyhydroxyalkanoates;

from about 0.01 weight percent to about 5.0 weight percent of at least one surfactant;

from about 0.01 weight percent to about 5.0 weight percent of at least one rheology modifier;

from about 0.01 weight percent to about 2.5 weight percent of at least one wetting and dispersing agent; and

from about 0.01 weight percent to about 0.5 weight percent of at least one biocide or biostatic agent.

Claim 12. The biodegradable food service item of Claim 11, wherein the biodegradable substrate comprises a biodegradable plate, cup, bowl, fiber tray, or eating utensil.

Claim 13. The biodegradable food service item of Claim 11, wherein the coating is applied over the at least one food contact surface at a coating weight, on a dry basis, from about 2 to about 25 grams per square meter.

Claim 14. The biodegradable food service item of Claim 11, wherein the coating exhibits a Cobb water absorption value, measured according to TAPPI Standard T441, of less than 20 grams per square meter.

Claim 15. The biodegradable food service item of Claim 11, wherein the coating exhibits Kit Test grease resistance value, measured according to TAPPI Standard T559 cm-12, of greater than Kit Value 5.