

DESCRIPTION

TITLE OF INVENTION: COMPOSITION

TECHNICAL FIELD

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The present invention relates to a composition comprising: (i) a polyolefin; (ii) a fatty acid salt of a metal selected from Ce, Mn, Al, Mg and mixture of two or more thereof; and (iii) at least one fatty acid ester of sucrose, wherein the fatty acid ester of sucrose is substantially insoluble in ethanol at 50 °C. The invention also relates to a method for preparing the composition, to the use of the composition as an additive, and to an additive, preferably an additive masterbatch, comprising the composition. The invention further relates to a polymer composition comprising the additive, preferably an additive masterbatch, and a polymer base composition, and to a method of preparing a polymer composition comprising the additive and a polymer base composition. Additionally, the invention relates to an article comprising the polymer composition, to a method of preparing an article comprising the polymer composition, and to the use of the polymer composition to prepare an article.

BACKGROUND

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The use of polymer materials is ubiquitous in modern life. Depending on the particular choice of polymer, polymer materials are able to offer a variety of desirable physical properties, which make them suitable for a wide variety of different applications. Moreover, polymers typically comprise a backbone of strong covalent bonds, making the polymer resistant to degradation. In normal use, this property is beneficial, as it enables the provision of durable articles for use by the consumer.

However, owing to the strength of the covalent backbone, polymer materials are typically difficult to degrade or depolymerise, meaning that there are limited options for their disposal. As a result, polymer waste is often consigned to landfill sites and frequently leaks into the environment. This is highly undesirable from an environmental perspective. There is thus a desire to reduce the use of conventional polymer materials which cannot be readily degraded.

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A demand therefore exists for the development of degradable polymer materials, enabling articles comprising such materials to be more readily disposed of once they have fulfilled their intended use. This demand can be satisfied by the provision of a polymer degradation additive.

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A polymer degradation additive comprises a polymer carrier along with additional ingredients intended to speed up polymer degradation, and may be supplied as a masterbatch. The masterbatch may be blended with a polymer base composition, and the resultant polymer composition may be processed to form an article. The presence of the masterbatch in the polymer composition facilitates degradation of the article on disposal.

It is known that chemical degradation of the polymer base can be enhanced by the provision of a chemical depolymerisation catalyst in the masterbatch. These species promote oxidative depolymerisation of the covalent backbone of the polymer base. The provision of a biofood in the degradation additive is also known to enhance degradation by recruiting microorganisms to the polymer base, enabling these microorganisms to bio-assimilate the polymer base and/or degradation products. These two effects act concurrently and in complement to enhance degradation.

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The strong degradation performance described above must be carefully balanced with the physical properties demanded of the polymer composition during normal use of an article. For example, the inclusion of the masterbatch should not compromise mechanical properties – e.g. tensile strength or elongation at break – relative to those of the polymer base composition alone. This is important so that the polymer composition can continue to perform its intended function, without any substantial decrease in performance which may be noticed by the end-user. The masterbatch should also not too greatly affect the visual appearance of the polymer composition as compared with the polymer base composition alone. This is important to ensure that articles comprising the masterbatch will not appear aesthetically unappealing to the consumer.

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SUMMARY OF THE INVENTION

Viewed from a first aspect, the present invention provides a composition, comprising:

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- (i) a polyolefin,

- (ii) a fatty acid salt of a metal selected from Ce, Mn, Al, Mg, and a mixture of two or more thereof, and
 - (iii) at least one fatty acid ester of sucrose
- wherein the fatty acid ester of sucrose is substantially insoluble in ethanol at 50 °C.

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Viewed from a further aspect, the present invention provides a method for preparing a composition as hereinbefore described, comprising mixing:

- (i) a polyolefin,
 - (ii) a fatty acid salt of a metal selected from Ce, Mn, Al, Mg, and a mixture of two or more thereof, and
 - (iii) at least one fatty acid ester of sucrose
- wherein the fatty acid ester of sucrose is substantially insoluble in ethanol at 50 °C.

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Viewed from a further aspect, the present invention provides an additive, preferably an additive masterbatch, comprising a composition as hereinbefore described.

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Viewed from a further aspect, the present invention provides the use of a composition as hereinbefore described as an additive, preferably an additive masterbatch.

Viewed from a further aspect, the present invention provides a polymer composition comprising:

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- (i) an additive, preferably an additive masterbatch, as hereinbefore described; and
- (ii) a polymer base composition.

Viewed from a further aspect, the present invention provides a method for preparing a polymer composition as hereinbefore described, comprising blending an additive, preferably an additive masterbatch, as hereinbefore described with a polymer base composition.

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Viewed from a further aspect, the present invention provides an article comprising a polymer composition as hereinbefore described.

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Viewed from a further aspect, the present invention provides the use of a polymer composition as hereinbefore described to prepare an article.

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Viewed from a further aspect, the present invention provides a method of preparing an article as hereinbefore described, comprising thermoforming, calendaring, casting, moulding (e.g. blow moulding, injection moulding, compression moulding) and/or extruding (e.g. blow film extruding) a polymer composition as hereinbefore described.

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DEFINITIONS

As used herein, the term “polymer degradation additive” refers to a composition which improves the degradation properties of a polymer base composition with which it is blended. The compositions of the present invention may be used as polymer degradation additives.

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As used herein, the term “additive masterbatch” refers to an additive in a form which may be blended with a polymer base composition to form a polymer composition, with the aim of imparting certain desired properties to the resultant polymer composition.

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As used herein the term “polymer base composition” refers to a composition with which an additive or an additive masterbatch is blended to form a polymer composition. Preferably the polymer base composition is the main ingredient of the resultant polymer composition by wt%, based on the total weight of the polymer composition. For example, the polymer composition may comprise the polymer base composition in an amount of at least 50 wt%, preferably at least 60 wt% and more preferably at least 90% based on the total weight of the polymer composition. Preferably the polymer base composition comprises a polymer as its main ingredient by wt%. For example, the polymer base composition may comprise polymer in an amount of at least 70 wt%, preferably at least 80 wt% and more preferably at least 90% based on the total weight of the polymer composition. Other ingredients optionally present in the polymer base composition are conventional additives (other than polymer degradation additives).

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As used herein the term “polymer composition” refers to a composition resulting from the blending of an additive or an additive masterbatch with a polymer base composition.

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As used herein, the term “homopolymer” refers to a polymer derived from one single species of monomer.

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As used herein, the term “copolymer” refers to a polymer derived from more than one species of monomer. The term includes block copolymers, random copolymers, and alternating copolymers.

5 As used herein the term “polyolefin” refers to a polymer that comprises at least 50 % wt, preferably at least 75 % wt, more preferably at least 85 % wt, yet more preferably at least 90 % wt units derived from olefin(s). Preferred olefins are ethylene and propene, in particular ethylene.

10 As used herein the term “polyethylene” refers to a polymer that comprises at least 50 % wt, preferably at least 75 % wt, more preferably at least 85 % wt, yet more preferably at least 90 % wt units derived from ethylene.

As used herein the term “stearate” refers to the anion of stearic acid.

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As used herein the term “depolymerisation catalyst” refers to a metal salt which catalyses the depolymerisation of a polymer.

As used herein the term “fatty acid” refers to an aliphatic carboxylic acid.

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As used herein the term “biofood” refers to a compound which may be consumed by microorganisms and which promotes the proliferation of said microorganisms.

25 As used herein, the term “wt%” refers to weight percent, which is the percentage by weight of a component relative to the total weight of the composition, unless otherwise specified.

As used herein, the term “%solubility” refers to solubility of compound, which is calculated from the following equation:

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$$\text{Percent (\%) Solubility} = (W_0 - W_R) \times 100/W_0$$

wherein

W_0 is the weight of compound prior to mixing with specific solvent and/or liquid,

W_R is the weight of solid that remains after mixing with a specific solvent and/or liquid under predetermined conditions, then filtering and drying under predetermined

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conditions.

As used herein, the term “insoluble” or “substantially insoluble” refers to a compound that, under predetermined conditions, either

1. Does not dissolve, or dissolves only to a negligible extent, in a specific solvent and/or liquid such that no homogeneous solution is formed, the compound remains visible as a distinct solid phase (e.g., as a suspension and/or precipitate), and the liquid phase is transparent or substantially transparent to the naked eye. Any dissolution of the compound under these conditions is minimal and does not materially affect the overall appearance or behaviour of the mixture; and/or
2. Results in a solid residue of not less than 80 wt% based on the total weight of said compound remaining after filtration and drying under the specified conditions. In other words; and/or
3. %solubility is less than about 20%.

As used herein, the term “partially soluble” refers to a compound that, under predetermined conditions, either

1. Dissolve in a given solvent and/or liquid to a limited extent such that some portion of the compound remains as a distinct solid phase (e.g., as a suspension and/or precipitate), and the liquid phase may be partially transparent or slightly turbid to quite turbid to the naked eye. The degree of dissolution is greater than negligible but insufficient to form a fully homogeneous solution; and/or
2. Results in a solid residue of greater than 10 to less than 80 wt% based on the total weight of said compound that remains after filtration and drying under the specified conditions; and/or
3. %Solubility is about 20% to less than 90%.

As used herein, the term “soluble” refers to a compound that, under predetermined conditions, either

1. Dissolves in a specific solvent and/or liquid to form a homogeneous solution, wherein the compound is present at a concentration sufficient to produce a transparent or substantially transparent liquid phase, without visible solid particles or phase separation to the naked eye;
2. Results in a solid residue of less than or equal to 10 wt% based on the total weight of said compound that remains after filtration and drying under the predetermined conditions. Quantitatively, the compound remains dissolved at a concentration equal to or greater than a defined threshold concentration under the

predetermined conditions, and any undissolved residue after filtration and drying is negligible or below a predetermined minimal amount; and/or

3. %Solubility is greater than or equal to about 90%.

5 As used herein, the term "acid value" refers to acid value of free acid which is calculated from the equation below.

$$\text{Acid value} = (n/m) \times N \times Mr$$

where n = amount of titrant (KOH) used (mL)

m = amount of sample to prepare the solution (g)

10 N = normality of the potassium hydroxide (KOH) solution

Mr = molecular weight of potassium hydroxide, 56.11

The test method to determine free acid are described herein. Twenty-five (25) g of pellet form of sample is cryogenically milled to get the final particle size around 100 microns under liquid nitrogen, with a ball mill device. The fine powder of sample (10 g) is dissolved in a 95:5 mixture of ethanol and petroleum ether (50 ml), then heated until reflux for 2 hours. Undissolved matters are filtered off by filtration paper. The filtrate is adjusted to a final volume of 50 ml by a 95:5 mixture of ethanol and petroleum ether. Phenolphthalein (1-2 drops) was added to the resulting solution. Then, a standard solution of 0.1 N potassium hydroxide (KOH), previously standardization with a 0.1 N hydrochloric acid solution, was used to titrate with the sample mixture until the permanent pink color is seen, which is considered the titration end point. Volume of KOH (ml) is recorded.

DETAILED DESCRIPTION

25 The present invention relates to a composition comprising

- (i) a polyolefin,
- (ii) a fatty acid salt of a metal selected from Ce, Mn, Al, Mg, and a mixture of two or more thereof, and
- (iii) at least one fatty acid ester of sucrose

30 wherein the fatty acid ester of sucrose is substantially insoluble in ethanol at 50 °C.

Some compositions comprise a fatty acid salt of one metal, or each of two metals, or each of three metals, or of each metal selected from Ce, Mn, Al and Mg.

Preferably, the composition comprises a fatty acid salt of each of two metals selected from Ce, Mn, Al and Mg. More preferably, the composition comprises a fatty acid salt of Ce and a fatty acid salt of Mn.

5 Preferably, the composition of the present invention is an additive, more preferably an additive masterbatch.

10 The present invention also relates to an additive, more preferably an additive masterbatch, comprising a composition as hereinbefore described and to the use of a composition as hereinbefore described as an additive, more preferably an additive masterbatch.

15 The present invention additionally relates to a polymer composition comprising an additive, more preferably an additive masterbatch, as hereinbefore described and a polymer base composition.

20 Advantageously, the composition or the polymer composition of the present invention offers improved degradation performance. This means that articles comprising the composition or the polymer composition more readily degrade, including following UV-accelerated weathering and/or light exposure. Advantageously, the mechanical properties of the composition or the polymer composition of the present invention do not differ significantly from the mechanical properties of the polyolefin which does not comprise the fatty acid salt of metal and the fatty acid ester of sucrose, or a polymer base composition which does not comprise the additive or the additive masterbatch of the present invention, respectively. For example, the tensile strength and elongation at
25 break of the composition or the polymer composition of the present invention are not significantly different from those of the polyolefin which does not comprise the fatty acid salt of metal and the fatty acid ester of sucrose, or a polymer base composition which does not comprise the additive or the additive masterbatch of the present invention, respectively.

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Polyolefin

35 The composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a polyolefin. The composition, preferably an additive, more preferably an additive masterbatch, may comprise multiple polyolefins. For example, the composition, preferably an additive, more preferably an additive masterbatch, may

comprise two, three, or more polyolefins. Preferably, the composition of the present invention comprises a single polyolefin.

5 The polyolefin of the present invention may be a copolymer, for example a bipolymer, a terpolymer, or a quaterpolymer. Preferably, the polyolefin of the present invention is a homopolymer.

10 Preferably, the polyolefin is selected from a polyolefin comprising monomers derived from a C2-C12 olefin, more preferably a C2-C8 olefin. Still more preferably, the polyolefin is selected from a polyethylene (e.g. a high density polyethylene, medium density polyethylene, low density polyethylene, linear low density polyethylene, or the mixture thereof) or a polypropylene. More preferably, the polyolefin is polyethylene, still more preferably low density polyethylene (LDPE), linear low density polyethylene (LLDPE), or the mixture thereof.

15 Preferably, the polyolefin is in the form of a powder or particles.

20 Preferably, the polyolefin of the present invention has an M_w of 10,000 to 700,000 g/mol, more preferably 50,000 to 600,000 g/mol, still more preferably 70,000 to 500,000 g/mol, still more preferably 80,000 to 400,000 g/mol, still more preferably 90,000 to 300,000 g/mol, still more preferably 100,000 to 200,000 g/mol, still more preferably 100,000 to 150,000 g/mol. Preferably, the polyolefin of the present invention has an M_n of 5,000 to 80,000 g/mol, more preferably 10,000 to 60,000 g/mol, still more preferably 13,000 to 50,000 g/mol, still more preferably 13,000 to 40,000 g/mol, still more preferably 14,000 to 40,000 g/mol, still more preferably 20,000 to 40,000 g/mol, still more preferably 20,000 to 30,000 g/mol. Preferably, the polyolefin of the present invention has an M_z of 100,000 to 1,100,000 g/mol, more preferably 200,000 to 1,000,000 g/mol, still more preferably 250,000 to 800,000 g/mol, still more preferably 250,000 to 600,000 g/mol, still more preferably 300,000 to 600,000 g/mol, still more preferably 350,000 to 550,000 g/mol, still more preferably 400,000 to 500,000 g/mol.

35 Preferably, the polyolefin, more preferably polyethylene, of the present invention has a melt flow rate (MFR) 0.04 to 100 g/10 min at loading 2.16 kg at 190 °C, more preferably 0.5 to 50 g/10 min, still more preferably about 0.5 to 20 g/10 min, still more preferably about 0.5 to 10 g/10 min, still more preferably about 0.8 to 5 g/10 min, still more preferably about 0.9 to 1.5 g/10 min, still more preferably about 0.9 to 1.2 g/10 min, still

more preferably about 1.0 to 1.2 g/10 min, most preferably 1 g/10 min. Another preferably, the polyolefin, more preferably polyethylene, of the present invention has a melt flow rate (MFR) 4 to 8 g/10 min at loading 2.16 kg at 190 °C or 0.04 to 10 g/10 min at loading 2.16 kg at 190 °C or 0.04 to 1.5 g/10 min at loading 2.16 kg at 190 °C.

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Preferably, the polyolefin, more preferably polypropylene, of the present invention has a melt flow rate (MFR) 2 to 65 g/10 min at loading 2.16 kg at 230 °C, more preferably 2 to 25 g/10 min, still more preferably about 2 to 12 g/10 min, most preferably 12 g/10 min. Alternatively, the polyolefin, more preferably polypropylene, of the present invention preferably has a melt flow rate (MFR) of 50 to 70 g/10 min at loading 2.16 kg at 230 °C or a melt flow rate (MFR) of 2 to 5 g/10 min at loading 2.16 kg at 230 °C.

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MFR may be measured according to ASTM D 1238 (Year 2020).

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The composition, preferably an additive, more preferably an additive masterbatch, of the present invention preferably comprises 30 to 85 wt% polyolefin, more preferably 40 to 85 wt% polyolefin, still more preferably 50 to 85 wt% polyolefin, still more preferably 50 to 75 wt% polyolefin, still more preferably 55 to 75 wt% polyolefin, still more preferably 55 to 70 wt% polyolefin, yet more preferably 55 to 65 wt% polyolefin, based on the total weight of the composition. Another preferably, composition, preferably an additive, more preferably an additive masterbatch, of the present invention preferably comprises 15 to 50 wt% polyolefin, more preferably 20 to 50 wt% polyolefin, still more preferably 25 to 40 wt% polyolefin, based on the total weight of the composition.

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Preferably the polyolefin is the main ingredient of the composition, preferably an additive, more preferably an additive masterbatch, by wt%, based on the total weight of the composition. The composition, preferably an additive, more preferably an additive masterbatch, of the present invention preferably comprises 50 to 90 wt% polyolefin, more preferably 59 to 75 wt% polyolefin, based on the total weight of the composition.

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Fatty acid salts of metals selected from Ce, Mn, Al, Mg and a mixture of two or more thereof

The composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of a metal selected from Ce, Mn, Al, Mg and a mixture of two or more thereof. In other words, the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises one or more

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of: a fatty acid salt of Ce; a fatty acid salt of Mn; a fatty acid salt of Al; or a fatty acid salt of Mg.

5 A purpose of this ingredient is to act as a depolymerisation catalyst. Such a depolymerisation catalyst promotes oxidative depolymerisation of a polymer backbone, leading to advantageous levels of polymer degradation in a composition or a polymer composition comprising an additive, preferably an additive masterbatch, of the present invention.

10 Preferably the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of one metal selected from Ce, Mn, Al and Mg. In such compositions, the metal is preferably Ce.

15 Preferably, the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of each of two metals selected from Ce, Mn, Al, and Mg. In other words, the composition, preferably an additive, more preferably an additive masterbatch, of the present invention may comprise one or more of the following combinations: a fatty acid salt of Ce and a fatty acid salt of Al; a fatty acid salt of Ce and a fatty acid salt of Mn; a fatty acid salt of Ce and a fatty acid salt of Mg; a fatty acid salt of Mn and a fatty acid salt of Al; a fatty acid salt of Mn and a fatty acid salt of Mg; or a fatty acid salt of Al and a fatty acid salt of Mg. More preferably, the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of Ce and a fatty acid salt of Mn.

25 Preferably, the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of each of three metals selected from Ce, Mn, Al, and Mg. In other words, the composition, preferably an additive, more preferably an additive masterbatch, of the present invention may comprise one or more of the following combinations: a fatty acid salt of Ce, a fatty acid salt of Mn, and a fatty acid salt of Al; a fatty acid salt of Ce, a fatty acid salt of Al, and a fatty acid salt of Mg; a fatty acid salt of Ce, a fatty acid salt of Mn, and a fatty acid salt of Mg; or a fatty acid salt of Mn, a fatty acid salt of Al, and a fatty acid salt of Mg.

35 Most preferably, the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of each of Ce, Mn, Al,

and Mg. In other words, the composition, preferably an additive, more preferably an additive masterbatch, of the present invention may comprise a fatty acid salt of Ce, a fatty acid salt of Mn, a fatty acid salt of Al, and a fatty acid salt of Mg.

5 The composition, preferably an additive, more preferably an additive masterbatch, of the present invention may comprise multiple (for example two, three, or more) fatty acid salts of metals selected from Ce, Mn, Al, and Mg and mixtures thereof. In other words, the composition, preferably an additive, more preferably an additive masterbatch, may
10 comprise multiple fatty acids salts of Ce, multiple fatty acid salts of Mn, multiple fatty acid salts of Al, and/or multiple fatty acid salts of Mg.

The fatty acid salt may be a salt of an unsaturated fatty acid or of a saturated fatty acid. Preferably, the fatty acid salt is a salt of a saturated fatty acid.

15 Preferably, in the composition, preferably an additive, more preferably an additive masterbatch, of the present invention the fatty acid salt is a salt of a C4-28 fatty acid, more preferably a C14-24 fatty acid, still more preferably a C16-20 fatty acid. Most preferably the fatty acid salt is a salt of a C18 fatty acid.

20 Preferably, in the composition, preferably an additive, more preferably an additive masterbatch, of the present invention the fatty acid salt is a salt of a fatty acid containing an even number of carbon atoms. Preferably, in the compositions, preferably an additive, more preferably an additive masterbatch, of the present invention the fatty acid salt is a salt of a monocarboxylic fatty acid.

25 Preferably, in the composition, preferably an additive, more preferably an additive masterbatch, of the present invention, the fatty acid salt is a salt of stearic acid.

30 Where the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises several fatty acid salts, each fatty acid salt may be a salt of the same or of a different fatty acid. Preferably, each fatty acid salt present in the composition, preferably an additive, more preferably an additive masterbatch, of the present invention is a salt of the same fatty acid.

35 Preferably, in the composition, preferably an additive, more preferably an additive masterbatch, of the present invention, the fatty acid salt of a metal comprising fatty acid

having 14 to 24 carbon atoms, preferably 16 to 20 carbon atoms, still more preferably 18 carbon atoms, most preferably wherein the fatty acid salt is a salt of stearic acid.

5 Preferably, the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises 5 to 30 wt%, more preferably 10 to 30 wt%, still more preferably 15 to 30 wt%, still more preferably 15 to 25 wt% of fatty acid salts of metals selected from Ce, Mn, Al, Mg and a mixture of two or more thereof, based on the total weight of the composition, preferably an additive, more preferably an additive masterbatch.

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Where the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of Ce, the composition, preferably an additive, more preferably an additive masterbatch, comprises 0 to 30 wt%, preferably 5 to 25 wt%, more preferably 5 to 20 wt%, still more preferably 10 to 20 wt%, yet more
15 preferably 10 to 15 wt% of a fatty acid salt of Ce, based on the total weight of the composition, preferably an additive, more preferably an additive masterbatch.

Where the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of Mn, the composition, preferably an
20 additive, more preferably an additive masterbatch, comprises 0 to 30 wt%, preferably 5 to 25 wt%, more preferably 5 to 20 wt%, still more preferably 10 to 20 wt%, yet more preferably 10 to 15 wt% of a fatty acid salt of Mn, based on the total weight of the composition, preferably an additive, more preferably an additive masterbatch.

25 Where the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of Al, the composition, preferably an additive, more preferably an additive masterbatch, comprises 0 to 30 wt%, preferably 5 to 25 wt%, more preferably 5 to 20 wt%, still more preferably 10 to 20 wt%, yet more preferably 10 to 15 wt% of a fatty acid salt of Al, based on the total weight of the
30 composition, preferably an additive, more preferably an additive masterbatch.

Where the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of Mg, the composition, preferably an additive, more preferably an additive masterbatch, comprises 0 to 30 wt%, preferably 5
35 to 25 wt%, more preferably 5 to 20 wt%, still more preferably 10 to 20 wt%, yet more

preferably 10 to 15 wt% of a fatty acid salt of Mg, based on the total weight of the composition, preferably an additive, more preferably an additive masterbatch.

Where the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of Ce and a fatty acid salt of Mn, the weight ratio of said fatty acid salt of Ce to said fatty acid salt of Mn is preferably 0.1:1 to 2:1, more preferably 0.5:1 to 1.5:1, still more preferably 0.8:1 to 1:1, most preferably about 1:1. In a more preferred composition, more preferably an additive and still more preferably an additive masterbatch, the weight ratio of said fatty acid salt of Ce to said fatty acid salt of Mn is preferably 0.5:1 to 2.2:1, more preferably 0.6:1 to 2.2:1, still more preferably 0.7:1 to 2:1, still more preferably 0.7:1 to 1.8:1, still more preferably 0.7:1 to 1.5:1, still more preferably 0.7:1 to 1.3:1, and still more preferably 0.9:1 to 1.3:1.

Where the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of Al and a fatty acid salt of Ce, the weight ratio of said fatty acid salt of Al to said fatty acid salt of Ce is preferably 0:1 to 2:1, more preferably 0:1 to 1.5:1, still more preferably to 0:1 to 1:1, still more preferably 0:1 to 0.5:1, still more preferably to 0:1 to 0.3:1, most preferably 0:1 to 0.1:1.

Where the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of Mg and a fatty acid salt of Ce, the weight ratio of said fatty acid salt of Mg to said fatty acid salt of Ce is preferably 0:1 to 2:1, more preferably 0:1 to 1.5:1, still more preferably to 0:1 to 1:1, still more preferably 0:1 to 0.5:1, still more preferably to 0:1 to 0.3:1, most preferably 0:1 to 0.1:1.

Where the composition, preferably an additive, more preferably an additive masterbatch of the present invention comprises a fatty acid salt of Mg and a fatty acid salt of Al, the weight ratio of said fatty acid salt of Mg to said fatty acid salt of Al is preferably 3:1 to 1:3, more preferably 2:1 to 1:2, still more preferably 1.5:1 to 1:1.5, most preferably about 1:1. In a preferred composition, more preferably an additive, and still more preferably an additive masterbatch, the weight ratio of said fatty acid salt of Mg to said fatty acid salt of Al is preferably 0.5:1 to 2.2:1, more preferably 0.6:1 to 2.2:1, still more preferably 0.7:1 to 2:1, still more preferably 0.7:1 to 1.8:1, still more preferably 0.7:1 to 1.5:1, still more preferably 0.7:1 to 1.3:1, still more preferably 0.9:1 to 1.3:1.

Where the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of Mg and a fatty acid salt of Mn, the weight ratio of said fatty acid salt of Mg to said fatty acid salt of Mn is preferably 0:1 to 2:1, more preferably 0:1 to 1.5:1, still more preferably to 0:1 to 1:1, still more preferably 5 0:1 to 0.5:1, still more preferably to 0:1 to 0.3:1, most preferably 0:1 to 0.1:1.

Where the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of Al and a fatty acid salt of Mn, the weight ratio of said fatty acid salt of Al to said fatty acid salt of Mn is preferably 0:1 to 2:1, 10 more preferably 0:1 to 1.5:1, still more preferably to 0:1 to 1:1, still more preferably 0:1 to 0.5:1, still more preferably to 0:1 to 0.3:1, most preferably 0:1 to 0.1:1.

Fatty acid ester of sucrose

The composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid ester of sucrose. In other words, the 15 composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises one or more of fatty acid ester of sucrose.

A purpose of this ingredient is to act as a biofood. Such a biofood is to recruit 20 microorganisms to a polymer base. This enhances biodegradation of a composition or a polymer composition comprising the additive, preferably an additive masterbatch, of the present invention. It has also been found that the inclusion of the fatty acid ester of sucrose leads to improved degradation performance, including following UV-accelerated weathering, in compositions and polymer compositions comprising the additive, 25 preferably an additive masterbatch, of the present invention, as compared with comparative compositions and polymer compositions lacking the fatty acid ester of sucrose.

Where the composition, preferably an additive, more preferably an additive masterbatch, 30 of the present invention comprises several fatty acid ester of sucrose, each fatty acid ester may be an ester of the same or of a different fatty acid. Preferably, each fatty acid ester present in the composition, preferably an additive, more preferably an additive masterbatch, of the present invention is an ester of the same fatty acid.

35 The fatty acid ester may be an ester of an unsaturated fatty acid or of a saturated fatty acid. Preferably, the fatty acid ester is an ester of a saturated fatty acid.

Preferably, in the composition, preferably an additive, more preferably an additive masterbatch, of the present invention the fatty acid ester of sucrose comprises a fatty acid ester having 2 to 40 carbon atoms, preferably 8 – 24 carbon atoms, more preferably 12 – 18 carbon atoms, most preferably 16 – 18 carbon atoms.

Preferably, in the composition, preferably an additive, more preferably an additive masterbatch, of the present invention the fatty acid ester is an ester of a fatty acid containing an even number of carbon atoms. In a preferred composition, more preferably an additive, and still more preferably an additive masterbatch, of the present invention the fatty acid ester of sucrose comprises a fatty acid ester having 16 carbon atoms and fatty acid ester having 18 carbon atoms.

Preferably, in the composition, preferably an additive, more preferably an additive masterbatch, of the present invention, the fatty acid ester is selected from an ester of stearic acid, an ester of palmitic acid, and a mixture thereof. More preferably, the fatty acid ester is a mixture of the ester of stearic acid and the ester of palmitic acid.

Preferably, in the composition, preferably an additive, more preferably an additive masterbatch, of the present invention, the fatty acid ester of sucrose comprises a fatty acid ester having 16 carbon atoms, preferably ester of palmitic acid, and fatty acid ester having 18 carbon atoms, preferably ester of stearic acid, the weight ratio of the fatty acid ester having 16 carbon atoms, preferably ester of palmitic acid, to fatty acid ester having 18 carbon atoms, preferably ester of stearic acid, is preferably 0:1 to 1:1, more preferably 0.1:1 to 1:1, still more preferably 0.15:1 to 1:1, still more preferably 0.2:1 to 1:1, still more preferably 0.25:1 to 1:1, still more preferably 0.3:1 to 1:1, still more preferably 0.35:1 to 1:1, still more preferably 0.4:1 to 1:1, still more preferably 0.4:1 to 0.8:1, still more preferably 0.4:1 to 0.6:1, still more preferably 0.4:1 to 0.5:1. Another preferably, the weight ratio of the fatty acid ester having 16 carbon atoms, preferably ester of palmitic acid, to fatty acid ester having 18 carbon atoms, preferably ester of stearic acid, is preferably 0:1 or 1:0.

Preferably, in the compositions, preferably an additive, more preferably an additive masterbatch, of the present invention the fatty acid ester of sucrose comprises a fatty acid monoester of sucrose, a fatty acid diester of sucrose, a fatty acid triester of sucrose, a fatty acid tetraester of sucrose, a fatty acid pentaester of sucrose, a fatty acid hexaester

of sucrose, a fatty acid heptaester of sucrose, a fatty acid octaester of sucrose, or a mixture of two or more thereof.

5 Preferably, in the compositions, preferably an additive, more preferably an additive masterbatch, of the present invention the fatty acid ester of sucrose comprising a fatty acid monoester of sucrose in an amount of 0 to 25 wt%, preferably 0 to 20 wt%, more preferably 0 to 15 wt%, still more preferably 0 to 10, still more preferably 0 to 5 wt%, still more preferably 0 to 1 wt%, yet more preferably 0 to 0.5 wt%, most preferably 0.1 to 0.5 wt% based on the total weight of the fatty acid ester of sucrose. Another preferably, in
10 the compositions, preferably an additive, more preferably an additive masterbatch, of the present invention the fatty acid ester of sucrose comprising a fatty acid monoester of sucrose in an amount of 0.1 to less than 5 wt%, preferably 0.1 to 3 wt%, more preferably 0.1 to 1 wt%, still more preferably 0.1 to 0.8 wt% based on the total weight of the fatty acid ester of sucrose.

15 Preferably, in the compositions, preferably an additive, more preferably an additive masterbatch, of the present invention the fatty acid ester of sucrose comprising a fatty acid diester of sucrose in an amount of 0 to 25 wt%, preferably 0.5 to 20 wt%, more preferably 0.5 to 15 wt%, still more preferably 0.5 to 10, yet more preferably 0.5 to 5 wt%,
20 most preferably 0.5 to 1.5 wt% based on the total weight of the fatty acid ester of sucrose.

Preferably, in the compositions, preferably an additive, more preferably an additive masterbatch, of the present invention the fatty acid ester of sucrose comprising a fatty acid octaester of sucrose in an amount of 0 to 45 wt%, preferably 2 to 35 wt%, more
25 preferably 5 to 30 wt%, still more preferably 5 to 25 wt%, yet more preferably 5 to 22 wt%, most preferably 12 to 22 wt% based on the total weight of the fatty acid ester of sucrose.

30 Preferably, in the compositions, preferably an additive, more preferably an additive masterbatch, of the present invention the fatty acid ester of sucrose comprising a fatty acid monoester, diester, and octaester of sucrose in an amount of 1 to 50 wt%, preferably 1 to 20 wt%, more preferably 1 to 15 wt%, still more preferably 2 to 15 wt%, still more preferably 3 to 15 wt%, still more preferably 3 to 10 wt%, yet more preferably 3 to 8 wt%, most preferably 3 to 6 wt% based on the total weight of the fatty acid ester of sucrose.

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Preferably, in the compositions, preferably an additive, more preferably an additive masterbatch, of the present invention the fatty acid ester of sucrose comprising a fatty acid heptaester of sucrose in an amount of 5 to 40 wt%, preferably 5 to 30 wt%, more preferably 10 to 30 wt%, still more preferably 15 to 30 wt%, still more preferably 20 to 30 wt%, based on the total weight of the fatty acid ester of sucrose.

Preferably, the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises 5 to 25 wt%, more preferably 5 to 20 wt%, still more preferably 5 to 15 wt% of the fatty acid ester of sucrose, based on the total weight of the composition, preferably an additive, more preferably an additive masterbatch.

15 *Biofood*

The composition, preferably an additive, more preferably an additive masterbatch, of the present invention preferably also includes a further biofood (e.g. polyhydric alcohol, hydroxy acid, polybutylene adipate terephthalate, 1,4-cyclohexane dimethanol dibenzoate, capryloyl salicylic acid, ethyl cellulose) in addition to the one fatty acid ester of sucrose hereinbefore described. A purpose of the further biofood, in combination with the partially hydrolysed polyvinyl alcohol, is to recruit microorganisms to a polymer base. This enhances biodegradation of a polymer composition comprising the composition of the present invention.

Preferably, the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises further biofood in an amount of 0 to 25 wt%, more preferably 0 to 20 wt%, still more preferably 0 to 15 wt%, still more preferably 1 to 15 wt%, still more preferably 2 to 15 wt%, still more preferably 2 to 10 wt%, based on the total weight of the composition, preferably an additive, more preferably an additive masterbatch.

Preferably, the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises further biofood in an amount of 0 – 25 a polyhydric alcohol, preferably a polyhydric alcohol comprising 2 to 24 carbon atoms, more preferably a polyhydric alcohol comprising 2 to 12 carbon atoms, still more preferably a polyhydric alcohol comprising 4 to 6 carbon atoms. Preferred polyhydric

alcohols include sorbitol and erythritol. Preferably, the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises sorbitol.

5 Preferably, the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a carboxylic acid, more preferably a hydroxy acid, still more preferably a hydroxy acid comprising 1 to 12 carbon atoms, yet more preferably a hydroxy acid comprising 2 to 10 carbon atoms, most preferably a hydroxy acid comprising 4 to 8 carbon atoms. The carboxylic acid or the hydroxy acid
10 may contain one carboxylic acid group or more than one carboxylic acid group, for example two carboxylic acid groups or three carboxylic acid groups.

The composition, preferably an additive, more preferably an additive masterbatch, of the present invention may comprise 1,4-cyclohexanedimethanol dibenzoate.

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Additional fatty acid metal salts

The compositions, preferably an additive, more preferably an additive masterbatch, of the present invention may additionally comprise a fatty acid salt of a metal not selected from Ce, Mn, Al, Mg and mixtures thereof. Such fatty acid salts may be salts of any fatty
20 acid as hereinbefore described.

The compositions, preferably an additive, more preferably an additive masterbatch, of the present invention may comprise a fatty acid salt of Zn.

25 Where the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of Zn and a fatty acid salt of Ce, the weight ratio of said fatty acid salt of Zn to said fatty acid salt of Ce is preferably 3:1 to 1:3, more preferably 2:1 to 1:2, still more preferably 1.5:1 to 1:1.5, most preferably about 1:1.

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Where the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of Zn and a fatty acid salt of Al, the weight ratio of said fatty acid salt of Zn to said fatty acid salt of Al is preferably 3:1 to 1:3, more preferably 2:1 to 1:2, still more preferably 1.5:1 to 1:1.5, most preferably about 1:1.

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Where the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of Zn and a fatty acid salt of Mg, the weight ratio of said fatty acid salt of Zn to said fatty acid salt of Mg is preferably 3:1 to 1:3, more preferably 2:1 to 1:2, still more preferably 1.5:1 to 1:1.5, most preferably about 1:1.

Where the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of Mn and a fatty acid salt of Zn, the weight ratio of said fatty acid salt of Zn to said fatty acid salt of Mn is preferably 0:1 to 1:0, more preferably 0.2:1 to 1:0, most preferably about 0.5:1 to 1:0.

Where the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of Zn, the composition preferably comprises 0 to 12.5 wt%, more preferably 0.5 to 7.5 wt%, still more preferably about 1 to 5 wt%, yet more preferably 1.5 to 3 wt% of a fatty acid salt of Zn, based on the total weight of the composition, preferably an additive, more preferably an additive masterbatch.

Preferably, the composition, preferably an additive, more preferably an additive masterbatch, of the present invention does not comprise a fatty acid salt of Zn. Preferably the composition, preferably an additive, more preferably an additive masterbatch, of the present invention does not comprise Zn. This has the advantage of allowing the composition of the present invention to better meet with regulatory requirements which limit the allowable concentration of Zn.

Preferably, the composition, preferably an additive, more preferably an additive masterbatch of the present invention comprises a fatty acid salt of Ca.

Where the composition, preferably an additive, more preferably an additive masterbatch, of the present invention comprises a fatty acid salt of Ca, the composition preferably comprises 0 to 5 wt%, more preferably 0.1 to 5 wt%, still more preferably about 0.5 to 3 wt%, still more preferably about 0.5 to 2 wt%, still more preferably about 0.5 to 1.5 wt%, still more preferably about 0.5 to 1 wt%, yet more preferably 0.8 to 1 wt% of a fatty acid salt of Ca, based on the total weight of the composition, preferably an additive, more preferably an additive masterbatch.

Further Additives

The composition, preferably an additive, more preferably an additive masterbatch, of the present invention may include a wide variety of additives. Examples of additives that are optionally present in the composition of the invention include nucleating agents, dyes, pigments, colour pigments, plasticisers, hardeners, stabilisers, coupling agents, antioxidants, acid scavengers, lubricants and compatibilizers.

Preferred additives include phosphites including bis (2,4-di-*t*-butylphenyl) pentaerythritol disphosphite, tris(2,4-di-*tert*-butylphenyl)phosphite; pentaerythritol tetrakis(3,5-di-*tert*-butyl-4-hydroxyhydrocinnamate; carboxylic acid including stearic acid; and polyethylene g-Maleic anhydride. Preferably, the composition of the present invention comprises each of bis (2,4-di-*t*-butylphenyl) pentaerythritol disphosphite, pentaerythritol tetrakis(3,5-di-*tert*-butyl-4-hydroxyhydrocinnamate, and polyethylene g-Maleic anhydride.

Any additives present in the composition, preferably an additive, more preferably an additive masterbatch, are preferably present in an amount of 0 to 10 wt%, more preferably 0.25 to 7.5 wt%, still more preferably about 0.5 to 4 wt%, still more preferably about 0.5 to 3 wt%, still more preferably about 1 to 3 wt%, yet more preferably 1 to 2 wt% based on the total weight of the composition, preferably an additive, more preferably an additive masterbatch.

Compositions

Preferred compositions of the present invention comprise:

- (i) a polyolefin, preferably polyethylene or polypropylene;
 - (ii) a fatty acid salt of each of two metals selected from Ce, Mn, Al, and Mg;
 - (iii) at least one fatty acid ester of sucrose; and
 - (iv) optionally, a further biofood
- wherein the fatty acid ester of sucrose is substantially insoluble in ethanol at 50 °C.

Further preferred compositions of the present invention comprise

- (i) a polyolefin, preferably polyethylene or polypropylene;
 - (ii) a fatty acid salt of each of three metals selected from Ce, Mn, Al, and Mg;
 - (iii) at least one fatty acid ester of sucrose; and
 - (iv) optionally, a further biofood
- wherein the fatty acid ester of sucrose is substantially insoluble in ethanol at 50 °C.

Further preferred compositions of the present invention comprise:

- (i) a polyolefin, preferably polyethylene or polypropylene;
- (ii) a fatty acid salt of each of Ce, Mn, Al, and Mg;
- (iii) at least one fatty acid ester of sucrose; and
- 5 (iv) optionally, a further biofood

wherein the fatty acid ester of sucrose is substantially insoluble in ethanol at 50 °C.

Preferably, the composition of the present invention has an acid value in a range of 20 to 150, preferably 20 to 120, more preferably 20 to 100, still more preferably 20 to 90, still more preferably 20 to 80, still more preferably 20 to 75, still more preferably 20 to 70, still more preferably 20 to 65, still more preferably 25 to 65, still more preferably 30 to 65, still more preferably 30 to 60, still more preferably 30 to 55, still more preferably 30 to 50, still more preferably 30 to 45, still more preferably 30 to 40, yet more preferably 35 to 40. Another preferably, the composition of the present invention has an acid value
10 still more preferably 40 to 80, preferably 40 to 75, more preferably 40 to 70, still more preferably 40 to 65, still more preferably 45 to 65, still more preferably 50 to 65.

Additive or additive masterbatch

20 Preferably the compositions of the present invention are additives, more preferably additive masterbatches.

Viewed from a further aspect, the present invention provides an additive, preferably an additive masterbatch, comprising of a composition as hereinbefore described.
25 Preferably, the additive and/or additive masterbatch of the present invention consists of a composition as hereinbefore described.

Viewed from a further aspect, the present invention provides the use of a composition as hereinbefore described as an additive, preferably an additive masterbatch.

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Preferred additives and additive masterbatches of the present invention are as described above for the compositions of the present invention.

Particularly preferred additives and additive masterbatches of the present invention
35 comprise:

- (i) a polyolefin, preferably polyethylene or polypropylene;

- (ii) a fatty acid salt of each of two metals selected from Ce, Mn, Al, and Mg;
- (iii) at least one fatty acid ester of sucrose; and
- (iv) optionally, a further biofood

wherein

- 5 the fatty acid ester of sucrose is substantially insoluble in ethanol at 50 °C;
the fatty acid ester of sucrose comprising a fatty acid monoester of sucrose in an amount of 0 to 25 wt%, preferably 0 to 20 wt%, more preferably 0 to 15 wt%, still more preferably 0 to 10, still more preferably 0 to 5 wt%, still more preferably 0 to 1 wt%, yet more preferably 0 to 0.5 wt%, most preferably 0.1 to 0.5 wt% based on the total weight of the
- 10 fatty acid ester of sucrose;
the fatty acid ester of sucrose comprising a fatty acid diester of sucrose in an amount of 0 to 25 wt%, preferably 0.5 to 20 wt%, more preferably 0.5 to 15 wt%, still more preferably 0.5 to 10, yet more preferably 0.5 to 5 wt%, most preferably 0.5 to 1.5 wt% based on the total weight of the fatty acid ester of sucrose;
- 15 the fatty acid ester of sucrose further comprising a fatty acid octaester of sucrose in an amount of 0 to 45 wt%, preferably 2 to 35 wt%, more preferably 5 to 30 wt%, still more preferably 5 to 25 wt%, yet more preferably 5 to 22 wt%, most preferably 12 to 22 wt% based on the total weight of the fatty acid ester of sucrose; and
the weight ratio of each fatty acid salt of Ce to the fatty acid salt of Mn is 0.1:1 to 2:1,
- 20 preferably 0.5:1 to 1.5:1, more preferably 0.8:1 to 1:1, most preferably 1:1.

Particularly preferred additives and additive masterbatches of the present invention comprise:

- (i) a polyolefin, preferably polyethylene or polypropylene;
- 25 (ii) a fatty acid salt of each of two metals selected from Ce, Mn, Al, and Mg;
- (iii) at least one fatty acid ester of sucrose; and
- (iv) optionally, a further biofood

wherein

- 30 the fatty acid ester of sucrose comprising a fatty acid monoester of sucrose in an amount of 0 to 25 wt%, preferably 0 to 20 wt%, more preferably 0 to 15 wt%, still more preferably 0 to 10, still more preferably 0 to 5 wt%, still more preferably 0 to 1 wt%, yet more preferably 0 to 0.5 wt%, most preferably 0.1 to 0.5 wt% based on the total weight of the fatty acid ester of sucrose;
- the fatty acid ester of sucrose comprising a fatty acid diester of sucrose in an amount of
- 35 0 to 25 wt%, preferably 0.5 to 20 wt%, more preferably 0.5 to 15 wt%, still more preferably

0.5 to 10, yet more preferably 0.5 to 5 wt%, most preferably 0.5 to 1.5 wt% based on the total weight of the fatty acid ester of sucrose;

the fatty acid ester of sucrose further comprising a fatty acid octaester of sucrose in an amount of 0 to 45 wt%, preferably 2 to 35 wt%, more preferably 5 to 30 wt%, still more preferably 5 to 25 wt%, yet more preferably 5 to 22 wt%, most preferably 12 to 22 wt% based on the total weight of the fatty acid ester of sucrose. the weight ratio of each fatty acid salt of Ce to the fatty acid salt of Mn is 0.1:1 to 2:1, preferably 0.5:1 to 1.5:1, more preferably 0.8:1 to 1:1, most preferably 1:1.

Further particularly preferred additives and additive masterbatches of the present invention comprise:

- (i) a polyolefin, preferably polyethylene or polypropylene;
- (ii) a fatty acid salt of each of two metals selected from Ce, Mn, Al, and Mg;
- (iii) at least one fatty acid ester of sucrose;
- (iv) calcium stearate;
- (v) optionally, additive selected from antioxidant, compatibilizer

wherein

the fatty acid ester of sucrose is substantially insoluble in ethanol at 50 °C;

the fatty acid ester of sucrose comprising a fatty acid monoester of sucrose in an amount of 0 to 25 wt%, preferably 0 to 20 wt%, more preferably 0 to 15 wt%, still more preferably 0 to 10, still more preferably 0 to 5 wt%, still more preferably 0 to 1 wt%, yet more preferably 0 to 0.5 wt%, most preferably 0.1 to 0.5 wt% based on the total weight of the fatty acid ester of sucrose;

the fatty acid ester of sucrose comprising a fatty acid diester of sucrose in an amount of 0 to 25 wt%, preferably 0.5 to 20 wt%, more preferably 0.5 to 15 wt%, still more preferably 0.5 to 10, yet more preferably 0.5 to 5 wt%, most preferably 0.5 to 1.5 wt% based on the total weight of the fatty acid ester of sucrose;

the fatty acid ester of sucrose further comprising a fatty acid octaester of sucrose in an amount of 0 to 45 wt%, preferably 2 to 35 wt%, more preferably 5 to 30 wt%, still more preferably 5 to 25 wt%, yet more preferably 5 to 22 wt%, most preferably 12 to 22 wt% based on the total weight of the fatty acid ester of sucrose. the weight ratio of each fatty acid salt of Ce to the fatty acid salt of Mn is 0.1:1 to 2:1, preferably 0.5:1 to 1.5:1, more preferably 0.8:1 to 1:1, most preferably 1:1; and

an acid value of additives, preferably additive masterbatches, is in a range of 20 to 150, preferably 20 to 120, more preferably 20 to 100, still more preferably 20 to 90, still more

preferably 20 to 80, still more preferably 20 to 75, still more preferably 20 to 70, still more preferably 20 to 65, still more preferably 25 to 65, still more preferably 30 to 65.

Manufacture

5 The present invention also relates to a method for preparing a composition, an additive, or an additive masterbatch as hereinbefore described, comprising mixing:

- (i) a polyolefin,
- (ii) a fatty acid salt of a metal selected from Ce, Mn, Al, Mg and mixtures thereof, and

10 (iii) at least one fatty acid ester of sucrose

wherein the fatty acid ester of sucrose is substantially insoluble in ethanol at 50 °C.

Preferred methods for preparing the composition, the additive, or the additive masterbatch of the present invention comprise high speed mixing all ingredients in powder form at ambient temperature (e.g. 25 to 45°C) to obtain dry blending.

Preferred methods for preparing the composition, the additive, or the additive masterbatch of the present invention further comprise melt mixing the dry blending by using an extruder, preferably a twin-screw extruder, between 150 and 200 °C, then pelletizing and storing the pellets in a sealed bag at 25 to 45°C.

Preferred methods of the present invention comprise mixing a fatty acid salt of each of two metals selected from Ce, Mn, Al, Mg and mixtures thereof with (i) and (iii).

25 Preferred methods of the present invention comprise mixing a fatty acid salt of each of three metals selected from Ce, Mn, Al, Mg and mixtures thereof with (i) and (iii).

Preferred methods of the present invention comprise mixing a fatty acid salt of each of Ce, Mn, Al, and Mg with (i) and (iii).

30

The present invention also relates to a method for preparing a polymer composition as hereinbefore described, comprising blending an additive, preferably an additive masterbatch, as hereinbefore described with a polymer base composition as hereinbefore described.

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Preferred methods for preparing the polymer composition of the present invention comprise blending all ingredients by physical mixing at ambient temperature and/or extrusion at 150 to 200 °C.

5 *Polymer composition*

Viewed from a further aspect, the present invention provides a polymer composition. The polymer composition comprises at least two components. The components are:

- (i) an additive, preferably an additive masterbatch, as hereinbefore described; and
- (ii) a polymer base composition.

10

Preferably the polymer base composition comprises a polyolefin. The polymer base composition may comprise a copolymer, for example a bipolymer, a terpolymer, or a quaterpolymer. Preferably, the polymer base composition comprises a homopolymer.

15

Preferably, the polymer base composition comprises a polyolefin comprising monomers derived from a C2-C12 olefin, more preferably a C2-C8 olefin. Still more preferably, the polymer base composition comprises a polyolefin selected from a polyethylene (e.g. a high density polyethylene, medium density polyethylene, low density polyethylene, linear low density polyethylene, or the mixture thereof) or a polypropylene. More preferably,

20

the polyolefin is polyethylene, still more preferably high density polyethylene, low density polyethylene, linear low density polyethylene, or the mixture thereof.

Preferably, the polymer base composition is in the form of a powder or particles.

25

Preferably, the polymer base composition of the present invention has an M_w of of 10,000 to 700,000 g/mol, more preferably 50,000 to 600,000 g/mol, still more preferably 70,000 to 500,000 g/mol, still more preferably 80,000 to 400,000 g/mol, still more preferably 90,000 to 300,000 g/mol, still more preferably 100,000 to 200,000 g/mol, still more preferably 100,000 to 150,000 g/mol. Preferably, the polyolefin of the present invention

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has an M_n of 5,000 to 80,000 g/mol, more preferably 10,000 to 60,000 g/mol, still more preferably 13,000 to 50,000 g/mol, still more preferably 13,000 to 40,000 g/mol, still more preferably 14,000 to 40,000 g/mol, still more preferably 20,000 to 40,000 g/mol, still more preferably 20,000 to 30,000 g/mol. Preferably, the polyolefin of the present invention has an M_z of 100,000 to 1,100,000 g/mol, more preferably 200,000 to 1,000,000 g/mol, still

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more preferably 250,000 to 800,000 g/mol, still more preferably 250,000 to 600,000

g/mol, still more preferably 300,000 to 600,000 g/mol, still more preferably 350,000 to 550,000 g/mol, still more preferably 400,000 to 500,000 g/mol.

5 The polymer composition of the present invention benefits from a number of advantageous properties. For example, the mechanical and physical properties of the polymer composition do not differ greatly from those of the polymer base composition. Preferably the mechanical and physical properties are determined by the methods described in the examples.

10 The polymer composition of the present invention preferably has a tensile strength of greater than 350 kg/cm², more preferably greater than 400 kg/cm², still more preferably greater than 450 kg/cm². The polymer composition of the present invention preferably has an elongation at break of greater than 1400%, more preferably greater than 1450%, still more preferably greater than 1,500%.

15 The polymer composition of the present invention preferably exhibits a increase in a tensile strength (e.g. tested according to method specified in ASTM D638-14) of 5 to 25%, preferably 15 to 25% compared to the polymer composition without the additive, preferably the additive masterbatch, hereinbefore described.

20 Advantageously, the polymer composition of the present invention also has improved degradation performance, including following UV-accelerated weathering and/or light exposure.

25 The polymer composition of the present invention preferably exhibits a reduction in M_w following UV-accelerated weathering (e.g. tested according to method specified in BSI PAS 9017:2020), e.g. as described in the examples, of greater than 80%, preferably greater than 90%, The polymer composition of the present invention preferably exhibits a reduction in M_w following light exposure of greater than 80%, preferably greater than 30 90%.

Advantageously, the polymer composition of the present invention combines strong degradation performance with mechanical and visual properties which do not differ significantly from those of the polymer base composition.

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The polymer composition of the present invention preferably has the tensile strength of greater than 350 kg/cm², more preferably greater than 400 kg/cm², still more preferably greater than 450 kg/cm², and exhibits a reduction in M_w following UV-accelerated weathering, e.g. as described in the examples, of greater than 80%, preferably greater than 90%. The polymer composition of the present invention more preferably has the tensile strength of greater than 350 kg/cm², more preferably greater than 400 kg/cm², still more preferably greater than 450 kg/cm², and exhibits a reduction in M_w following light exposure of greater than 80%, preferably greater than 90%.

Preferably the polymer composition of the present invention comprises 0.1 to 20 wt%, preferably 0.1 to 10 wt%, more preferably 0.5 to 5 wt%, most preferably 1 to 3 wt% of said additive, preferably said additive masterbatch, based on the total weight of polymer composition.

Preferably the polymer base composition is the main ingredient of the polymer composition by wt%, based on the total weight of the polymer composition. Preferably the polymer composition of the present invention comprises 80 to 99.9 wt%, preferably 90 to 99.9 wt%, more preferably 95 to 99.5 wt%, most preferably 97 to 99 wt% of the polymer base composition as hereinbefore described, based on the total weight of the polymer composition.

Preferably, the polymer composition of the present invention consists of an additive, preferably an additive masterbatch, as hereinbefore described and a polymer base composition.

The present invention also relates to a method of preparing a polymer composition as hereinbefore described comprising blending an additive, preferably an additive masterbatch as hereinbefore described with a polymer base composition.

Articles and uses

The present invention also relates to articles comprising a polymer composition as hereinbefore described. Example articles include containers, packaging for food and the like, grocery plastic supermarket bags, plastic shopping bags, garbage bags, agricultural film, mulch film. etc.

The articles of the present invention benefit from a number of advantageous properties. For example, the mechanical and physical properties of the article do not differ greatly from articles comprising a polymer base composition and lacking an additive, preferably an additive masterbatch, as hereinbefore described.

5

The articles of the present invention preferably have tensile strength of greater than 350 kg/cm², more preferably greater than 400 kg/cm², still more preferably greater than 450 kg/cm². The articles of the present invention preferably have the elongation at break of greater than 1400%, more preferably greater than 1450%, still more preferably greater than 1,500%.

10

The articles of the present invention preferably exhibits an increase in a tensile strength (e.g. tested according to method specified in ASTM D638-14 of 5 to 25%, preferably 15 to 25% compared to the article lacking the additive, preferably the additive masterbatch, hereinbefore described.

15

Advantageously, the articles of the present invention also have improved degradation performance, including following UV-accelerated weathering and/or light exposure.

20

The articles of the present invention preferably exhibit a reduction in M_w following UV-accelerated weathering (e.g. tested according to method specified in BSI PAS 9017:2020), e.g. as described in the examples, of greater than 80%, preferably greater than 90%. The articles of the present invention preferably exhibit a reduction in M_w following light exposure of greater than 80%, preferably greater than 90%, most preferably greater than 95%.

25

Advantageously, the articles of the present invention combine strong degradation performance with mechanical and visual properties which do not differ significantly from those of the polymer base composition.

30

The article of the present invention preferably has the tensile strength of greater than 350 kg/cm², more preferably greater than 400 kg/cm², still more preferably greater than 450 kg/cm², and exhibits a reduction in M_w following UV-accelerated weathering, e.g. as described in the examples, of greater than 80%, preferably greater than 90%, most preferably greater than 95%. The articles of the present invention more preferably has the tensile strength of greater than 350 kg/cm², more preferably greater than 400 kg/cm²,

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still more preferably greater than 450 kg/cm², and exhibits a reduction in M_w following light exposure of greater than 80%, preferably greater than 90%, most preferably greater than 95%.

5

The present invention also relates to a method for forming articles comprising conventional polymer processing techniques, such as blow/stretch moulding, and/or melt blowing/melt stretch processing, a polymer composition as hereinbefore described. Preferably, the moulding process is selected from a blow moulding process, a stretch
10 blow moulding process. Preferably, the extruding process is selected from a cast film process, or a blow film process. Where a blown film process is used, preferably the polymer base composition comprises a polymer having an MFR of 0.04 to 20 g/10 min, e.g. 0.04 to 5 g/10 min, more preferably 0.04 to 2 g/10 min, still more preferably 1 to 2 g/10 min at loading 2.16 kg at 190 °C. Where a melt blowing process is used, preferably
15 the polymer base composition comprises a polymer having an MFR of at least 125 g/10 min, and more preferably about at least 150 g/10 min at loading 2.16 kg at 190 °C. MFR may be measured according to ASTM D 1238 (Year 2020).

The present invention also relates to the use of a polymer composition as hereinbefore
20 described to form an article.

EXAMPLES

Materials

25 The polymers and compounds used in the Examples were all available commercially. The polymers and compounds used are summarised in the table A and B below.

Table A

Compound/Commercial grades	Suppliers	Main function
Cerium stearate	available commercially	Depolymerisation catalyst
Manganese stearate	available commercially	Depolymerisation catalyst
Sucrose ester S070, S107, S207, S1170, P1670	Mitsubishi Chemicals Ltd.	Biofood

Linear low density polyethylene powder(LLDPE), L2009FA (MFR = 1 g/10min, Melting Point = 122 °C)	SCG Chemicals PLC.	- Polyolefin - Polymer base composition
Bis(2,4-di-t-butylphenyl) pentaerythritol diphosphite plus stabilizer, ULTRANOX 627A	SI Group	Antioxidant
Pentaerythritol tetrakis(3,5-di-tert-butyl-4-hydroxyhydrocinnamate, Irganox 1010	BASF	Antioxidant
Calcium Stearate	available commercially	Acid scavenger
Polyethylene g-Maleic anhydride, LIOCENE PE MA 4351	Clariant Thailand Co., Ltd.	Compatibiliser

Table B

[illegible]

Preparation of Compositions

The Example compositions were prepared as masterbatches. A dry blend of all ingredients was prepared by using a high-speed mixing equipment (Micron Labomixer) at ambient temperature, without heating, for 2-5 mins. The resulting dry blend was
5 subjected to a twin screw extrusion (Thermo Scientific HAAKE TSE20 mm instruments) with the extruder temperature profile setting from the barrel to die as the following: 150/170/170/170/170/170/170/170/170 °C. The strand-like extrudate was cooled down with the water bath (ambient temperature around 25-30 °C), then pelletizing with the blade cutter at the cutter feeding speed between 4-6 kg/hr. The resultant composition
10 (masterbatch) in the form of pellets was then stored indoors under ambient temperature (25 to 45 °C, Thailand), well-ventilated conditions in a sealed polypropylene bag.

The resultant masterbatch compositions are summarised in Table 1, wherein the amounts of the ingredients are specified in wt% unless otherwise specified. All
15 ingredients were provided in pure, undiluted form.

Extrudate Visual Assessment

The extrudate strand of masterbatch compositions was visually assessed by naked eye immediately after exiting the die. The test results are shown in Table 2.
20

Pelletization Capability Assessment

Pelletization capability was evaluated by naked eye.

Table 1

[illegible]

Table 2

	1	2	6	CE1	CE2	PO1
Extrudate Visual Assessment	Off-white, uniform	Off-white, uniform	Off-white, uniform	Dark brown as burnt matters, Very low melt strength*	Dark brown as burnt matters, Very low melt strength*	Transluc ent, uniform
Pelletization Capability- Strand appearance	Able to cut into pellet	Able to cut into pellet	Able to cut into pellet	Cannot cut into pellet	Cannot cut into pellet	Able to cut into pellet
Pellet appearance	Round, Uniform, No Tail	Round, Uniform, No Tail	Round, Uniform, No Tail	-	-	Round, Uniform, No Tail

* Very low melt strength: The extrudate exhibits poor shape retention and is prone to sagging or deformation after exiting the die.

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The extrudate obtained from the compositions according to the present invention (Examples 1, 2, and 6) were off-white and visually uniform, indicating good thermal stability and absence of thermal degradation during processing. These extrudates were successfully pelletized, yielding round, uniform pellets with no tails, which are indicative of excellent processability and strand integrity.

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In contrast, comparative examples CE1 and CE2, which fall outside the scope of the invention, produced dark brown extrudates, indicating thermal degradation or burning during extrusion. As a result, these compositions could not be pelletized, as the extrudates were unable to form the strand, preventing it from cutting into a resulting pellets. As a result, no defined pellet morphology could be observed.

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These results clearly demonstrate that the inventive compositions provide superior thermal stability and processability, enabling consistent and high-quality pellet formation, whereas the comparative compositions fail to meet these performance criteria.

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Preparation of Samples for Testing

For biodegradability testing (UV-accelerated weathering test), the above masterbatch compositions were blended at 2 wt% with a polyethylene base composition (L2009FA).

5 The blended polymer composition was blown into a film with thickness of 35 ± 5 microns at a blown condition of 170 °C using a Blown film HD/LD Small Machine, with LDPE and/or HDPE die configurations. The blown film sample was then cut into a 5 x 7 cm specimen.

10 LLDPE powder (L2009FA) was used as the polymer base composition for preparing samples for biodegradability testing (UV-accelerated weathering test) and mechanical property testing (tensile strength, elongation at break). Its molecular weight properties were as follows, as determined by gel permeation chromatography:

M_w = 123,400 g/mol

15 M_n = 24,800 g/mol

M_z = 462,900 g/mol

Test Methods

UV-accelerated weathering test according to BSI PAS 9017:2020 (4.3.2)

20 This test is a measure of polymer degradation under conditions of UV irradiation.

Laboratory equipment for UV irradiation was developed in accordance with BSI PAS 9017:2020, with the irradiation source temperature, and irradiation cycle being consistent with those stipulated in the standard. The cycle of the equipment was set to the following:

- 25
- Irradiance: 0.80 W/m² (± 0.02 W/m²)
 - UV cycle time: 1 h
 - Dark cycle time: 23 h
 - Air chamber temperature: 60 °C (± 2 °C)

Samples were subject to UV-accelerated weathering for a total of 14 days.

30

Gel permeation chromatography was then used to determine the following parameters:

- Percentage of weight average molecular Weight (M_w) reduction compared to the starting M_w before UV-accelerated weathering
- Number average molecular weight (M_n)
- 35 • Z-average molecular weight (M_z)

The results are shown in Table 3.

Gel permeation chromatography (GPC) Analysis:

Samples after UV-accelerated weathering tests were then submitted for molecular weight analysis.

Molecular weights (MW), including number average molecular weight (M_n), weight average molecular weight (M_w), and z-average molecular weight (M_z), are measured by the high temperature gel permeation chromatography (HT-GPC or herein called GPC) with online IR6 detector, from Polymer Char, Valencia, Spain. In-house distilled *ortho*-dichlorobenzene (*o*-DCB) containing 200 ppm butylated hydroxytoluene (*BHT*) is used as the mobile phase and as the dissolution solvent.

To prevent the injection of incompletely dissolved polymer or contaminants (e.g., soil, dust) into the GPC columns, the following sample preparation protocol is implemented.

A polymer sample approximately 8 mg, obtained from at least five different positions on the specimen, is placed in a 10-mL vial. Eight mL of ambient temperature *o*-DCB (containing 200 ppm *BHT*) is manually added in the sample vial. The sample is then dissolved with gentle shaking for 90 minutes in an external dissolution oven (EDO, Polymer Char, Spain) at 150°C. The hot solution is immediately transferred (within 10 seconds) for filtration using an External Filtration System (EFS, Polymer Char, Spain), which is maintained at 160°C. A cartridge filter is pre-heated in the EFS oven for a minimum of 5 minutes prior to filtration to ensure thermal equilibrium is reached. The clean filtered solution, yielding approximately 6 mL, is collected in a new, clean 10-mL vial and allowed to cooldown to ambient temperature before GPC analysis.

The vial containing the filtered solution is then placed in the GPC autosampler. Subsequently, approximately 2 mL of additional *o*-DCB and 20 μ L of *n*-heptane (EMSURE®, Reag. Ph Eur, Merck KGaA, Darmstadt, Germany) are added. The vial is then incubated in an autosampler at 150 °C for 90 minutes with gentle agitation to ensure complete re-dissolution of the polymer in the solution. The amount of additional *o*-DCB depends on the yield of the filtered solution and is adjusted to bring the total solution volume to 8 mL. This step prevents injection of air or gas from vial headspace to the GPC system. To prevent degradation during sample dissolution, the vial headspace is filled with dried Nitrogen (N_2) after all solvents are added. The heptane peak is used as a flow marker (FM) in data processing for molecular weight calculation; for long-term

consistency, the flow marker is used to correct the pump flow rate. The *FM* is controlled to be within 0.5% of the nominal *FM* determined during column calibration.

5 The 200 μ L polymer solution is filtrated through an online sample filter and a guard column (PLgel 10 μ m Guard 50 x 7.5 mm; Agilent Technologies, USA). Separation is performed using three PLgel-Olexis columns in series (300 mm x 7.5 mm, 13 μ m particle size; Agilent Technologies, USA) at a flow rate of 0.5 mL/min. The column and detector compartment temperatures are maintained at 140 °C and 150 °C, respectively.

10 Column calibration is performed using fourteen narrow molecular weight distribution Polystyrene (PS) standards (Polymer Standards Service GmbH, PSS, Mainz, Germany) having peak molecular weights (M_p) ranging from 682 g/mol to 12,000,000 g/mol. These standards are grouped into four separate mixtures for calibration. Each mixture contains standards with peak molecular weights separated by at least one decade. The total mass of each mixture is approximately 16 mg for mixtures containing 3 PS standards, and not exceeding 24 mg for mixtures containing 4 PS standards. Individual PS standards are included in each mixture at approximately 3 mg to 6 mg, with lower masses used for standards having higher M_p . Each PS mixture is dissolved in 8 mL of o-DCB at 150 °C for 30 minutes with gentle shaking. Similar to polymer sample, n-heptane is added during solvent filling to act as a flow marker. The vial headspace is filled with dried nitrogen (N_2) after solvent addition, similarly to sample preparation.

To calculate molecular weight of polyethylene (PE), the Mark-Houwink calibration method is implemented.^[1] The calibration curve is generated by fitting the elution volume versus the peak molecular weights (M_p) of the Polystyrene (PS) standard mixtures using a third-order polynomial equation. The *MW* calculation utilizes the generated PS calibration curve and the following Mark-Houwink (*MH*) parameters for o-DCB at 140 °C: exponent Alpha (α) = 0.700 for both PS and PE; MH constant for PS (K_{PS}) = 0.0001380 dL/g; and MH constant for PE (K_{PE}) = 0.0005060 dL/g. The molecular weight for polyethylene (M_{PE}) corresponding to an elution volume slice with a polystyrene molecular weight (M_{PS}) on the calibration curve is calculated according to Equation (1):

$$M_{PE} = \left[\frac{K_{PS}}{K_{PE}} (M_{PS})^{(\alpha_{PS}+1)} \right]^{1/(\alpha_{PE}+1)} \quad (\text{Equation 1})$$

Data processing for calibration curve generation and molecular weight plot, including average molecular weight (M_n , M_w , and M_z) calculation is performed using GPC One™ software (Polymer Char). The mass constant for IR6 detector is determined by using PE52K of 2 mg/mL (Nominal M_w = 52000 g/mol) obtained from American Polymer Standards (USA). The standard PE52K is prepared and measured with similar conditions earlier described for polymer samples.

Mechanical property test

This test is a measure of different mechanical properties of samples formed from compositions of the present invention.

A dumbbell shape specimen for tensile strength and elongation analyses were prepared by hand mixing a polyethylene base composition and masterbatch (for example, 2wt% of masterbatch as pellet form in 98wt% of polymer base composition as a pellet). The resulting blend was then subjected to blow into film with thickness of 35 ± 5 microns, using the blow temperature at 170°C. The resulting film was then cut into a dumbbell specimen ($W \times L \times H = 2 \times 17 \times 0.5$ cm). The specimens were then conditioned at 25°C, RH 60%, for at least 24 hours before being measured for each individual property. Tensile strength and elongation were measured by a Tinius Olsen 5ST universal testing machine according to the method specified in ASTM D638-14.

The results are shown in Table 4.

Results

UV-accelerated weathering

Table 3

	1	2	3	4	6	7
Starting Mw before UV-accelerated weathering (Da)	123,200	123,000	123,200	122,900	123,400	123,500
Mw after UV-accelerated weathering (Da)	7,400	9,800	6,600	7,100	7,600	6,800
Mw Decrease (%)	94.0	92.0	94.6	94.2	93.8	94.5

Mn after UV-accelerated weathering (Da)	1,700	2,000	1,100	1,200	1,700	1,600
Mz after UV-accelerated weathering (Da)	20,000	28,600	17,400	19,500	20,500	18,100
CI after UV-accelerated weathering	1.2	1.1	1.2	1.2	1.2	1.2

Samples 1- 5 comprising the fatty acid ester of sucrose according to the present invention showed strong performance in polymer degradation following UV-accelerated weathering. Each of these inventive samples showed a significant percentage decrease in M_w as compared with the starting M_w . The values of M_n and M_z following UV-accelerated weathering were also desirably low. This strong performance was observed for Samples 1, 2, and 3, demonstrating that the advantageous levels of degradation are maintained at different amount of the sucrose ester according to the present invention. This strong performance was also observed for Samples 2, 6, and 7, demonstrating that the advantageous levels of degradation are maintained with different amounts of fatty acid metal stearates when the fatty acid ester of sucrose according to the present invention is present.

Mechanical properties

Table 4

	2	3	PO1
Tensile strength (kg/cm ²)	461	398	379
Elongation at break (%)	1,519	1,522	1,542

The Samples comprising the fatty acid ester of sucrose according to the present invention had a tensile strength and elongation at break not significantly different from that of the polymer base composition (PO1). This effect was observed for different amount of the sucrose ester according to the present invention.

Overall, the results of Samples 2 and 3 show that blending a polymer base composition with 2 wt% of the masterbatch compositions of the present invention does not compromise key mechanical properties, as compared with a polymer base composition alone. This is advantageous as it means that articles comprising such masterbatch compositions retain desirable properties for everyday use. In addition, the polymer base

composition blending with the masterbatch compositions of the present invention is recyclable.

Summary

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Overall, the results of all examples show that the masterbatch compositions of the present invention are highly suitable as polymer degradation additives. Indeed, samples comprising the polymer compositions of the present invention pass the criteria set by *BSI/PAS 9017:2020*. Samples comprising the polymer compositions of the present invention also experience minimal impact on mechanical properties and visual appearance, meaning that articles comprising the compositions are suitable for use by the end-user. Highly desirable levels of polyolefin degradation, following UV-accelerated weathering, are observed for samples comprising the compositions of the present invention. This effect is demonstrated across different compositions of the present invention, comprising different wt% values and ratios of compositional ingredients and different biofoods.

10
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CLAIMS

1. A composition comprising:
 - (i) a polyolefin,
 - 5 (ii) a fatty acid salt of a metal selected from Ce, Mn, Al, Mg, and a mixture of two or more thereof, and
 - (iii) at least one fatty acid ester of sucrose
 wherein the fatty acid ester of sucrose is substantially insoluble in ethanol at 50 °C.
2. The composition according to claim 1, the fatty acid ester of sucrose comprising a fatty acid ester having 2 to 40 carbon atoms, preferably 8 – 24 carbon atoms, more preferably 12 – 18 carbon atoms, most preferably 16 – 18 carbon atoms.
3. The composition according to claim 1 or 2, the fatty acid ester of sucrose comprising a fatty acid monoester of sucrose in an amount of 0 to 25 wt%, preferably 0 to 20 wt%, more preferably 0 to 15 wt%, still more preferably 0 to 10 wt%, still more preferably 0 to 5 wt%, still more preferably 0 to 1 wt%, yet more preferably 0 to 0.5 wt%, most preferably 0.1 to 0.5 wt% based on the total weight of the fatty acid ester of sucrose.
4. The composition according to claim 1 or 2, the fatty acid ester of sucrose comprising a fatty acid diester of sucrose in an amount of 0 to 25 wt%, preferably 0.5 to 20 wt%, more preferably 0.5 to 15 wt%, still more preferably 0.5 to 10 wt%, yet more preferably 0.5 to 5 wt%, most preferably 0.5 to 1.5 wt% based on the total weight of the fatty acid ester of sucrose.
5. The composition according to any preceding claim, the fatty acid ester of sucrose further comprising a fatty acid octaester of sucrose in an amount of 0 to 45 wt%, preferably 2 to 35 wt%, more preferably 5 to 30 wt%, still more preferably 5 to 25 wt%, yet more preferably 5 to 22 wt%, most preferably 12 to 22 wt% based on the total weight of the fatty acid ester of sucrose.
6. The composition according to claim 1, wherein the polyolefin is selected from polypropylene, polyethylene, and a mixture thereof, preferably selected from high density polyethylene, medium density polyethylene, low density polyethylene, linear low density polyethylene, or the mixture thereof.
7. The composition according to claim 1, preferably comprising a fatty acid salt of each of two metals selected from Ce, Mn, Al, and Mg, preferably comprising a fatty acid salt of Ce and a fatty acid salt of Mn.
8. The composition according to claim 7, wherein the weight ratio of the fatty acid salt of a metal selected from Ce, Al, Mg, and a mixture of two or more thereof, preferably

Ce, to the fatty acid salt of Mn is 0.1:1 to 2:1, preferably 0.5:1 to 1.5:1, more preferably 0.8:1 to 1:1, most preferably 1:1.

9. The composition according to claim 1, 7 or 8, wherein the fatty acid salt of a metal comprising fatty acid salt having 14 to 24 carbon atoms, preferably 16 to 20 carbon atoms, still more preferably 18 carbon atoms, most preferably wherein the fatty acid salt is a salt of stearic acid.
10. The composition according to claim 1, wherein the fatty acid salt of a metal selected from Ce, Mn, Al, Mg, and a mixture of two or more thereof is in an amount of 5 to 30 wt%, more preferably 10 to 30 wt%, still more preferably 15 to 30 wt%, still more preferably 15 to 25 wt%, based on the total weight of the composition.
11. The composition according to claim 1, wherein the fatty acid ester of sucrose is in an amount of 5 to 25 wt%, preferably 5 to 20 wt%, more preferably 5 to 15 wt% based on the total weight of the composition.
12. The composition according to any preceding claim, further comprising an additive selected from an antioxidant, an acid scavenger, a compatibilizer, a lubricant, and mixtures thereof.
13. A method for preparing a composition according to any preceding claim, comprising mixing:
 - (i) a polyolefin,
 - (ii) a fatty acid salt of a metal selected from Ce, Mn, Al, Mg, and a mixture of two or more thereof, and
 - (iii) at least one fatty acid ester of sucrose
 wherein the fatty acid ester of sucrose is substantially insoluble in ethanol at 50 °C.
14. An additive, preferably an additive masterbatch, comprising a composition according to any one of claims 1 to 12.
15. A polymer composition comprising:
 - (i) an additive, preferably an additive masterbatch, according to claim 12; and
 - (ii) a polymer base composition.
16. The polymer composition according to claim 15, wherein the polymer base composition is polyolefin selected from polypropylene, polyethylene, and a mixture thereof, preferably selected from high density polyethylene, medium density polyethylene, low density polyethylene, linear low density polyethylene, or the mixture thereof.
17. The polymer composition according to claim 15 or 16, comprising 0.1 to 20 wt%, preferably 0.1 to 10 wt%, more preferably 0.5 to 5 wt%, most preferably 1 to 3 wt%

of the additive, preferably the additive masterbatch, based on the total weight of the polymer composition.

- 5 18. The polymer composition according to any one of claims 15 to 17, wherein the polymer composition exhibits an increase in a tensile strength (e.g. tested according to method specified in ASTM D638-14 of 5 to 25%, preferably 15 to 25%, as compared to the tensile strength of the same polymer composition lacking an additive, preferably an additive masterbatch, according to claim 14, and/or wherein the polymer composition exhibits a reduction in M_w following a 14 days UV aging (e.g. tested according to method specified in BSI PAS 9017:2020) of greater than 10 90%.
19. An article comprising a polymer composition of any one of claims 15 to 18.