SYNERGISTS FOR HYPERBRANCHED POLYOL POLYMER PROCESSING ADDITIVES

FIELD

[0001] The present disclosure relates to synergists for use with hyperbranched polyol polymer processing additives and thermoplastic polymer compositions containing them.

SUMMARY

[0002] Briefly, the present disclosure provides compositions comprising a major amount of a thermoplastic polymer and an additive composition comprising a hyperbranched polyester polyol and a synergist selected from the group consisting of polyethylene glycols, polyethylene oxides, polycaprolactones and combinations thereof.

[0002a] In one aspect, the present disclosure provides a composition comprising greater than 50% by weight of a thermoplastic polymer and a polymer processing additive composition comprising:

(i) a hyperbranched polyester polyol, wherein the hyperbranched polyester polyol is a hydroxy-functional, hyperbranched polyester having functional end groups, in which at least 90 mole% of the functional end groups are hydroxy groups; and

(ii) a synergist selected from the group consisting of polyethylene glycols, poly(ethylene oxide)s, polycaprolactones and combinations thereof.

[0003] The present disclosure also provides methods for forming a film comprising blending a thermoplastic polymer with a hyperbranched polyester polyol and a synergist selected from the group consisting of polyethylene glycols, polyethylene oxides, polycaprolactones and combinations thereof to form a composition, and extruding the composition.

[0003a] In another aspect, the present disclosure provides a method for forming a film comprising:

A) blending a thermoplastic polymer with a hyperbranched polyester polyol and a synergist selected from the group consisting of polyethylene glycols, polyethylene oxides, polycaprolactones and combinations thereof to form a composition, and

B) extruding the composition;

wherein the hyperbranched polyester polyol is a hydroxy-functional, hyperbranched polyester having functional end groups, in which at least 90 mole% of the functional end groups are hydroxy groups.

[0004] The above summary of the present disclosure is not intended to describe each embodiment of the present invention. The details of one or more embodiments of the invention are also set forth in the description below. Other features, objects, and advantages of the invention will be apparent from the description and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] **FIG. 1** shows the effects of various synergists on the melt fracture reduction obtained with a hyperbranched polyester polyol polymer processing additive.

[0006] **FIG. 2** shows the effects of adding various amounts of a polyethylene glycol synergist on the melt fracture reduction obtained with a hyperbranched polyester polyol polymer processing additive.

[0007] **FIG. 3** shows the effects of adding a polycaprolactone synergist on the melt fracture reduction obtained with a hyperbranched polyester polyol polymer processing additive.

[0008] **FIG. 4** shows the effects of adding various poly(ethylene oxide) synergists on the melt fracture reduction obtained with a hyperbranched polyester polyol polymer processing additive.

[0009] **FIG. 5** shows the effects of adding a hyperbranched polyester polyol polymer processing additive and a synergist as a combined master batch processing additive on the melt fracture reduction.

What is Claimed is:

1. A composition comprising greater than 50% by weight of a thermoplastic polymer and a polymer processing additive composition comprising

(i) a hyperbranched polyester polyol, wherein the hyperbranched polyester polyol is a hydroxy-functional, hyperbranched polyester having functional end groups, in which at least 90 mole% of the functional end groups are hydroxy groups; and

(ii) a synergist selected from the group consisting of polyethylene glycols, poly(ethylene oxide)s, polycaprolactones and combinations thereof.

2. The composition of claim 1, wherein the composition comprises 100 to 3000 ppm by weight of the polymer processing additive composition based on the weight of the thermoplastic polymer.

3. The composition of claim 1 or 2, wherein the polymer processing additive composition comprises at least 100 ppm of the hyperbranched polyester polyol and at least 100 ppm of the synergist, based on the weight of the thermoplastic polymer.

4. The composition of any one of claims 1 to 3, wherein the weight ratio of the hyperbranched polyester polyol to the synergist is from 10:90 to 90:10.

5. The composition of claim 4, wherein the weight ratio of the hyperbranched polyester polyol to the synergist is from 25:75 to 75:25.

6. The composition according to any one of the preceding claims, wherein the synergist comprises a polyethylene glycol.

7. The composition of claim 6, wherein the polyethylene glycol has a number average molecular weight of 1000 to 50,000 Daltons as measured by Gel Permeation Chromatography using polyethylene glycol and poly(ethylene oxide) standards.

8. The composition according to any one of claims 1 to 5, wherein the synergist comprises a poly(ethylene oxide).

9. The composition of claim 8, wherein the poly(ethylene oxide) has a number average molecular weight of 10,000 to 500,000 Daltons as measured by Gel Permeation Chromatography using polyethylene glycol and poly(ethylene oxide) standards.

10. The composition according to any one of claims 1 to 5, wherein the synergist comprises a polycaprolactone.

11. The composition of claim 10, wherein the polycaprolactone has a number average molecular weight of 2,000 to 200,000 Daltons as measured by Gel Permeation Chromatography using polyethylene glycol and poly(ethylene oxide) standards.

12. The composition according to any one of the preceding claims, wherein the hyperbranched polyester polyol comprises 2,2-bis(methylol)propionic acid branching units.

13. The composition according to any one of the preceding claims, wherein the hyperbranched polyester polyol is a pseudo generation 2 hyperbranched polyester polyol with 16 hydroxyl functional groups.

14. The composition according to any one of the preceding claims, wherein the thermoplastic polymer comprises a polyolefin.

15. The composition of claim 14, wherein the polyolefin comprises a linear low density polyethylene.

16. A method for forming a film comprising:

A) blending a thermoplastic polymer with a hyperbranched polyester polyol and a synergist selected from the group consisting of polyethylene glycols, polyethylene oxides, polycaprolactones and combinations thereof to form a composition, and

B) extruding the composition;

wherein the hyperbranched polyester polyol is a hydroxy-functional, hyperbranched polyester having functional end groups, in which at least 90 mole% of the functional end groups are hydroxy groups.

17. The method of claim 16, wherein blending the thermoplastic polymer with the hyperbranched polyester polyol and the synergist to form the composition comprises blending the

hyperbranched polyester polyol and the synergist to form a polymer processing additive composition and blending the polymer processing additive composition with the thermoplastic polymer.

18. The method according to claim 16 or 17, wherein the composition comprises 100 to 3000 ppm of the combined amount of the hyperbranched polyester polyol and the synergist based on the total weight of the composition.

19. The composition according to any one of claims 1 to 15, wherein the composition comprises 100 to 3000 ppm of the polymer processing additive composition based on the total weight of the composition.