Harrison et al., U.S. Patent No. 6,358,892 discloses a succinimide composition that is prepared by reacting a mixture of an alkenyl or alkylsuccinic acid derivative, an unsaturated acidic reagent copolymer, and a polyamine under reactive conditions; then treating the reaction product with either a cyclic carbonate or a linear mono- or polycarbonate or boron compound under reactive conditions.

Harrison et al., U.S. Patent No. 6,451,920 discloses a process for preparing a mixture of (1) a copolymer of a polyalkene and an unsaturated acidic reagent and (2) a polyalkenyl derivative of an unsaturated acidic reagent.

Harrison et al., U.S. Patent No. 6,617,396 discloses a process for preparing a mixture of (1) a copolymer of a polyalkene and an unsaturated acidic reagent and (2) a polyalkenyl derivative of an unsaturated acidic reagent.

Kaplan, U.S. Patent No. 5,266,186 discloses dispersants which comprise polyimides which are prepared by reacting fatty amines with maleic anhydride/alpha-olefin copolymers.

SUMMARY OF THE INVENTION

It has now been discovered that the reaction product of copolymers and specific amine linking agents (i.e., diamine linking agents), results in a "hybrid succinic anhydride copolymer" product. This hybrid succinic anhydride copolymer may be reacted further with other amines or polyamines or mixtures thereof to form succinimide products that have good dispersant qualities, low viscosity, and shear stability. The succinimide may be reacted further with a post-treating agent.

In one embodiment, the present invention is directed to a post-treated succinimide additive composition prepared by a process which comprises

(A) reacting a copolymer of an (i) an unsaturated acidic reagent; and (ii) a mono-olefin, with at least one linking hydrocarbyl di-primary amine, thereby producing a hybrid succinic anhydride copolymer having from about 10% to about 90% unreacted anhydride groups; and subsequently

(B) reacting the hybrid succinic anhydride copolymer with a second amine compound, thereby producing a succinimide; and

(C) reacting the succinimide with at least one post-treating agent selected from a cyclic carbonate, a linear mono-carbonate, a linear poly-carbonate, an aromatic polycarboxylic acid, an aromatic polycarboxylic anhydride, an aromatic polycarboxylic acid ester, or mixtures thereof, thereby producing a post-treated succinimide additive composition.

In one embodiment, the present invention is directed to a lubricating oil composition comprising a major amount of an oil of lubricating viscosity and a minor amount of a post-treated succinimide additive composition prepared by the process which comprises (A) reacting a copolymer of an (i) an unsaturated acidic reagent; and (ii) a mono-olefin, with at least one linking hydrocarbyl di-primary amine, thereby producing a hybrid succinic anhydride copolymer having from about 10% to about 90% unreacted anhydride groups; and subsequently (B) reacting the hybrid succinic anhydride copolymer with a second amine compound, thereby producing a succinimide; and

(C) reacting the succinimide with at least one post-treating agent selected from a cyclic carbonate, a linear mono-carbonate, a linear poly-carbonate, an aromatic polycarboxylic acid, an aromatic polycarboxylic anhydride, an aromatic polycarboxylic acid ester, or mixtures thereof, thereby producing a post-treated succinimide additive composition.

In one embodiment, the present invention is directed to a method of making a post-treated succinimide additive composition comprises

(A) reacting a copolymer of an (i) an unsaturated acidic reagent; and (ii) a mono-olefin, with at least one linking hydrocarbyl di-primary amine, thereby producing a hybrid succinic anhydride copolymer having from about 10% to about 90% unreacted anhydride groups; and subsequently

(B) reacting the hybrid succinic anhydride copolymer with a second amine compound, thereby producing a succinimide; and

(C) reacting the succinimide with at least one post-treating agent selected from a cyclic carbonate, a linear mono-carbonate, a linear poly-carbonate, an aromatic polycarboxylic acid, an aromatic polycarboxylic anhydride, an aromatic polycarboxylic acid ester, or mixtures thereof, thereby producing a post-treated succinimide additive composition.

Accordingly, the present invention relates to multi-functional lubricating oil and fuel additives which are useful as dispersants.

DETAILED DESCRIPTION OF THE INVENTION

While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof and are herein described in detail. It should be understood, however, that the description herein of specific embodiments is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

Definitions

The following terms used with the description are defined as such:

The term "PIB" is an abbreviation for polyisobutene.

The term "PIBSA" is an abbreviation for polyisobutenyl succinic anhydride.

The term "copolymer" refers to a class of copolymers employed within the scope of the present invention which are copolymers of an olefin and an unsaturated acidic reagent, and more specifically, a monoethylenically

Harrison et al., U.S. Patent No. 6,358,892 discloses a succinimide composition that is prepared by reacting a mixture of an alkenyl or alkylsuccinic acid derivative, an unsaturated acidic reagent copolymer, and a polyamine under reactive conditions; then treating the reaction product with either a cyclic carbonate or a linear mono- or polycarbonate or boron compound under reactive conditions.

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Kaplan, U.S. Patent No. 5,266,186 discloses dispersants which comprise polyimides which are prepared by reacting fatty amines with maleic anhydride/alpha-olefin copolymers.

SUMMARY OF THE INVENTION

It has now been discovered that the reaction product of copolymers and specific amine linking agents (i.e., diamine linking agents), results in a "hybrid succinic anhydride copolymer" product. This hybrid succinic anhydride copolymer may be reacted further with other amines or polyamines or mixtures thereof to form succinimide products that have good dispersant qualities, low viscosity, and shear stability. The succinimide may be reacted further with a post-treating agent.

In one embodiment, the present invention is directed to a post-treated succinimide additive composition prepared by a process which comprises (A) reacting a copolymer of an (i) an unsaturated acidic reagent; and (ii) a

mono-olefin, with at least one linking hydrocarbyl di-primary amine, thereby producing a hybrid succinic anhydride copolymer having from 10% to 90 % unreacted anhydride groups; and subsequently

(B) reacting the hybrid succinic anhydride copolymer with a second amine compound, thereby producing a succinimide; and

(C) reacting the succinimide with at least one post-treating agent selected from a cyclic carbonate, a linear mono-carbonate, a linear poly-carbonate, an aromatic polycarboxylic acid, an aromatic polycarboxylic anhydride, an aromatic polycarboxylic acid ester, or mixtures thereof, thereby producing a post-treated succinimide additive composition;

wherein the hydrocarbyl group of the diamine compound linking agent is an aliphatic or aromatic group which contains only hydrogen and carbon.

In one embodiment, the present invention is directed to a lubricating oil composition comprising a major amount of an oil of lubricating viscosity and a minor amount of a post-treated succinimide additive composition as described herein.

In one embodiment, the present invention is directed to a method of making a post-treated succinimide additive composition comprising:

(A) reacting a copolymer of an (i) an unsaturated acidic reagent; and (ii) a mono-olefin, with at least one linking hydrocarbyl di-primary amine, thereby producing a hybrid succinic anhydride copolymer having from 10% to 90 % unreacted anhydride groups; and subsequently

(B) reacting the hybrid succinic anhydride copolymer with a second amine compound, thereby producing a succinimide; and

(C) reacting the succinimide with at least one post-treating agent selected from a cyclic carbonate, a linear mono-carbonate, a linear poly-carbonate, an aromatic polycarboxylic acid, an aromatic polycarboxylic anhydride, an aromatic polycarboxylic acid ester, or mixtures thereof, thereby producing a post-treated succinimide additive composition;

wherein the hydrocarbyl group of the diamine compound linking agent is an aliphatic or aromatic group which contains only hydrogen and carbon.

In one embodiment, the present invention is directed to a method of improving soot dispersancy in an internal combustion engine which comprises operating the engine with the lubricating oil composition comprising a major amount of oil of lubricating viscosity and an effective amount of the post-treated succinimide additive composition as described herein.

Accordingly, the present invention relates to multi-functional lubricating oil and fuel additives which are useful as dispersants.

DETAILED DESCRIPTION OF THE INVENTION

While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof and are herein described in detail. It should be understood, however, that the description herein of specific embodiments is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

Definitions

The following terms used with the description are defined as such:

The term "PIB" is an abbreviation for polyisobutene.

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The term "copolymer" refers to a class of copolymers employed within the scope of the present invention which are copolymers of an olefin and an unsaturated acidic reagent, and more specifically, a monoethylenically

WHAT IS CLAIMED IS:

1. A post-treated succinimide additive composition prepared by a process which comprises

(A) reacting a copolymer of an (i) an unsaturated acidic reagent; and (ii) a mono-olefin, with at least one linking hydrocarbyl di-primary amine, thereby producing a hybrid succinic anhydride copolymer having from about 10% to about 90% unreacted anhydride groups; and subsequently

(B) reacting the hybrid succinic anhydride copolymer with a second amine compound, thereby producing a succinimide; and

(C) reacting the succinimide with at least one post-treating agent selected from a cyclic carbonate, a linear mono-carbonate, a linear poly-carbonate, an aromatic polycarboxylic acid, an aromatic polycarboxylic anhydride, an aromatic polycarboxylic acid ester, or mixtures thereof, thereby producing a post-treated succinimide additive composition.

2. The post-treated succinimide additive composition of Claim 1 wherein the at least one linking hydrocarbyl di-primary amine is selected from the group consisting of ethylene diamine; 1,6-diaminohexane; and 1,12-diaminododecane.

3. The post-treated succinimide additive composition of Claim 1 wherein the second amine compound is at least one of an aliphatic or aromatic monoamine or polyamine or mixtures thereof.

4. The post-treated succinimide additive composition of Claim 3 wherein the second amine compound is a primary amine.

5. The post-treated succinimide additive composition of Claim 4 wherein the second amine compound is a polyamine.

6 The post-treated succinimide additive composition of Claim 5 wherein the second amine compound is a heavy polyamine, having at least 6.5 nitrogen atoms per mole of polyamine.

7. A lubricating oil composition comprising a major amount of an oil of lubricating viscosity and a minor amount of a post-treated succinimide additive composition prepared by the process which comprises

(A) reacting a copolymer of an (i) an unsaturated acidic reagent; and (ii) a mono-olefin, with at least one linking hydrocarbyl di-primary amine, thereby producing a hybrid succinic anhydride copolymer having from about 10% to about 90% unreacted anhydride groups; and subsequently

(B) reacting the hybrid succinic anhydride copolymer with a second amine compound, thereby producing a succinimide; and

(C) reacting the succinimide with at least one post-treating agent selected from a cyclic carbonate, a linear mono-carbonate, a linear poly-carbonate, an aromatic polycarboxylic acid, an aromatic polycarboxylic anhydride, an aromatic polycarboxylic acid ester, or mixtures thereof, thereby producing a post-treated succinimide additive composition.

8. The lubricating oil composition of Claim 7 wherein the at least one linking diamine is selected from the group consisting of ethylene diamine; 1,6-diaminohexane; and 1,12-diaminododecane.

9. The lubricating oil composition of Claim 7 wherein the second amine compound is at least one of an aliphatic or aromatic monoamine or polyamine or mixtures thereof.

10. The lubricating oil composition of Claim 9 wherein the second amine compound is a primary amine.

11. The lubricating oil composition of Claim 9 wherein the second amine compound is a polyamine.

12. The lubricating oil composition of Claim 11 wherein the second amine compound is a heavy polyamine, having at least 6.5 nitrogen atoms per mole of polyamine.

13. A method of making a post-treated succinimide additive composition comprises

(A) reacting a copolymer of an (i) an unsaturated acidic reagent; and (ii) a mono-olefin, with at least one linking hydrocarbyl di-primary amine, thereby producing a hybrid succinic anhydride copolymer having from about 10% to about 90% unreacted anhydride groups; and subsequently

(B) reacting the hybrid succinic anhydride copolymer with a second amine compound, thereby producing a succinimide; and

(C) reacting the succinimide with at least one post-treating agent selected from a cyclic carbonate, a linear mono-carbonate, a linear poly-carbonate, an aromatic polycarboxylic acid, an aromatic polycarboxylic anhydride, an aromatic polycarboxylic acid ester, or mixtures thereof, thereby producing a post-treated succinimide additive composition.

14. A method of improving soot dispersancy in an internal combustion engine which comprises operating the engine with the lubricating oil composition comprising a major amount of oil of lubricating viscosity and an effective amount of the post-treated succinimide additive composition of claim 1.

WHAT IS CLAIMED IS:

1. A post-treated succinimide additive composition prepared by a process which comprises (A) reacting a copolymer of an (i) an unsaturated acidic reagent; and (ii) a mono-olefin, with at least one linking hydrocarbyl di-primary amine, thereby producing a hybrid succinic anhydride copolymer having from 10% to 90 % unreacted anhydride groups; and subsequently
(B) reacting the hybrid succinic anhydride copolymer with a second amine compound, thereby producing a succinimide; and
(C) reacting the succinimide with at least one post-treating agent selected from a cyclic carbonate, a linear mono-carbonate, a linear poly-carbonate, an aromatic polycarboxylic acid, an aromatic polycarboxylic anhydride, an aromatic polycarboxylic acid ester, or mixtures thereof, thereby producing a post-treated succinimide additive composition;
wherein the hydrocarbyl group of the diamine compound linking agent is an aliphatic or aromatic group which contains only hydrogen and carbon.

2. The post-treated succinimide additive composition of Claim 1 wherein the at least one linking hydrocarbyl di-primary amine is selected from the group consisting of ethylene diamine; 1,6-diaminohexane; and 1,12-diaminododecane.

3. The post-treated succinimide additive composition of Claim 1 wherein the second amine compound is at least one of an aliphatic or aromatic monoamine or polyamine or mixtures thereof.

4. The post-treated succinimide additive composition of Claim 3 wherein the second amine compound is a primary amine.

5. The post-treated succinimide additive composition of Claim 4 wherein the second amine compound is a polyamine.

6. The post-treated succinimide additive composition of Claim 5 wherein the second amine compound is a heavy polyamine, having at least 6.5 nitrogen atoms per mole of polyamine.

7. A lubricating oil composition comprising a major amount of an oil of lubricating viscosity and a minor amount of a post-treated succinimide additive composition as claimed in any preceding claim.

8. A method of making a post-treated succinimide additive composition comprising:
(A) reacting a copolymer of an (i) an unsaturated acidic reagent; and (ii) a mono-olefin, with at least one linking hydrocarbyl di-primary amine, thereby producing a hybrid succinic anhydride

copolymer having from 10% to 90 % unreacted anhydride groups; and subsequently
(B) reacting the hybrid succinic anhydride copolymer with a second amine compound, thereby producing a succinimide; and
(C) reacting the succinimide with at least one post-treating agent selected from a cyclic carbonate, a linear mono-carbonate, a linear poly-carbonate, an aromatic polycarboxylic acid, an aromatic polycarboxylic anhydride, an aromatic polycarboxylic acid ester, or mixtures thereof, thereby producing a post-treated succinimide additive composition;
wherein the hydrocarbyl group of the diamine compound linking agent is an aliphatic or aromatic group which contains only hydrogen and carbon.

9. The method of Claim 8 wherein the at least one linking hydrocarbyl di-primary amine is selected from the group consisting of ethylene diamine; 1,6-diaminohexane; and 1,12-diaminododecane.

10. The method of Claim 8 wherein the second amine compound is at least one of an aliphatic or aromatic monoamine or polyamine or mixtures thereof.

11. The method of Claim 10 wherein the second amine compound is a primary amine.

12. The method of Claim 11 wherein the second amine compound is a polyamine.

13. The method of Claim 12 wherein the second amine compound is a heavy polyamine, having at least 6.5 nitrogen atoms per mole of polyamine.

14. A method of improving soot dispersancy in an internal combustion engine which comprises operating the engine with the lubricating oil composition comprising a major amount of oil of lubricating viscosity and an effective amount of the post-treated succinimide additive composition of any one of claims 1 to 6.

15. The use of a post-treated succinimide additive composition of any one of claims 1 to 6 as an additive in a lubricating oil composition for improving soot dispersancy.