from having sterically hindered amine moieties, and therefore have a reduced negative impact on the longevity of fluoro-elastomer seals but may still impact seal quality and longevity depending on the treat rate of such amine functionalized DVM.

SUMMARY

[0003a] In a first aspect, the present disclosure refers to a multi-functional olefin copolymer lubricant additive comprising a reaction product of an acylated olefin copolymer and an amino mono- or di-carboxylic acid, the reaction product optionally further reacted with an amine, ester, or alcohol functionalization agent, and wherein the amino mono- or di-carboxylic acid has the formula

$H_2N\text{-}R_1(R_2)\text{-}COOH$

wherein

R_1 is a C1 to C18 hydrocarbyl group;

R_2 is hydrogen, a linear or branched alkyl group, an aryl group, a hydroxyphenyl group, a heterocyclic amino group, a carboxyl group, an amido group, an amino group, a hydroxyl group, a thiol, a thioester, selenium, or combinations thereof; and

wherein the acylated olefin copolymer is derived from a copolymer of ethylene and one or more C3 to C18 alpha-olefins and a grafted ethylenically unsaturated carboxylic acid material selected from acrylic acid, methacrylate acid, cinnamic acid, crotonic acid, maleic acid, fumaric acid or anhydride derivatives thereof.

[0003b] In another aspect, the present disclosure refers to a lubricant composition comprising a major amount of base oil of lubricating viscosity and a multi-functional olefin copolymer viscosity modifier disclosed herein.

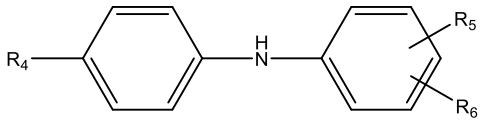
[0003c] In a further aspect, the present disclosure refers to a use of the multi-functional olefin copolymer lubricant additive as disclosed herein in a lubricant composition for lubricating a machine part and to minimize degradation of seals.

[0004] In one approach or example, a multi-functional olefin copolymer lubricant additive comprising a reaction product of an acylated olefin copolymer and an amino mono- or di-carboxylic acid is described herein. The reaction product is optionally further reacted with an amine, ester, or alcohol functionalization agent. The amino mono- or di-carboxylic acid has the formula $H_2N\text{-}R_1(R_2)\text{-}COOH$ wherein R_1 is a C1 to C18 hydrocarbyl group and R_2 is hydrogen, a

linear or branched alkyl group, an aryl group, a hydroxyphenyl group, a heterocyclic amino group, a carboxyl group, an amido group, an amino group, a hydroxyl group, a thiol, a thioester, selenium, or combinations thereof.

[0005] In other approaches or examples, the multi-functional olefin copolymer lubricant additive of the previous paragraph can be combined with and/or include additional features that may be any of or any combination of the following: wherein the amine, ester, or alcohol functionalization agent is selected from aromatic amines, polyaromatic amines, primary amines, secondary amines, primary or secondary alcohols, napthyl alkyl amines, and mixtures thereof; and/or wherein the reaction product is formed in either the L or D isomeric form; and/or wherein the reaction product is either neutral or ionic; and/or wherein the acylated olefin copolymer includes an olefin copolymer having grafted thereon from 0.1 to 0.8 carboxylic groups per 1000 number average molecular weight units of the olefin copolymer; and/or wherein the olefin copolymer has a number average molecular weight between about 5,000 and about 200,000 as measured by GPC using polystyrene as reference; and/or wherein R_1 is a methylene group and R_2 is the heterocyclic amino group selected from an indole alkyl group or an imidazole alkyl group; and/or wherein the amino mono- or di-carboxylic acid is selected from amino hexanoic acid, 2-amino-3-phenyl propanoic acid, 2-amino-3-(1H-indol-3-yl) propanoic acid, 2-amino-3-(1H-imidazol-5-yl) propanoic acid, 2-amino butane dioic acid, 2-amino pentane dioic acid, 2-amino-4-methylpentanoic acid, and mixtures thereof; and/or wherein the reaction product is further reacted with the amine functionalization agent and wherein a primary or secondary amine thereof is capped with an oxazoline or derivative thereof; and/or wherein the oxazoline or

derivative thereof is 2-phenyl-2-oxazoline; 2-ethyl-2 oxazoline; 2-methyl-2-oxazoline; 2-benzyl-4,4-dimethyl-2-oxazoline; 2-ethyl-4,4-dimethyl-2 oxazoline; 2,4,4-trimethyl-2-oxazoline; 4,4-dimethyl-2-oxazoline; 2,4,5-trimethyl-3-oxazoline; 2-(2,6-dimethoxyphenyl)-4,4-dimethyl-2-oxazoline; 2-[1-(hydroxymethyl)ethyl] oxazoline; mixtures thereof, or derivatives thereof; and/or wherein the reaction product is further reacted with the amine functionalization agent and wherein the amine functionalization agent is selected from N-arylphenylene-diamine, 1-(2-amino-ethyl)-imidazolidin-2-one, N-(3-aminopropyl) morpholine, 3-(dimethylamino)-1-propylamine, N-phenyl-p-phenylenediamine, N-(3-aminopropyl)-2 pyrrolidinone, aminoethylacetamide, alanine methyl ester, 1-(3-aminopropyl) imidazole, polyetheramine, phenoxypropylamine, aromatic derivatives thereof, and combinations thereof; and/or wherein the amine functionalization agent is an N-arylphenylene-diamine of the formula



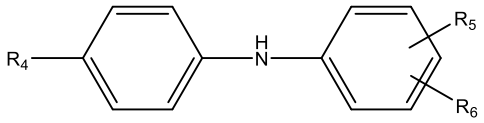
wherein R_4 is hydrogen, --NH-aryl, --NH-arylalkyl, --NH-alkyl, or a branched or straight chain radical having from 4 to 24 carbon atoms that can be alkyl, alkenyl, alkoxyl aralkyl, alkaryl, hydroxyalkyl or aminoalkyl; R_5 is --NH_2, CH_2 --$(CH_2)_n$ --NH_2, or CH_2 -aryl-NH_2, in which n is an integer from 1 to 10; and R_6 is hydrogen, alkyl, alkenyl, alkoxyl, aralkyl, or alkaryl having from 4 to 24 carbon atoms; and/or wherein the N-arylphenylene-diamine is selected from N-phenyl-1,4-phenylenediamine; N-phenyl-1,3-phenylendiamine; N-phenyl-1,2-phenylenediamine; and mixtures thereof; and/or wherein the acylated olefin copolymer is derived from a copolymer of ethylene and one or more C3 to C18 alpha-olefins and a grafted ethylenically unsaturated carboxylic acid material having at least one ethylenic bond and at least one carboxylic acid group or anhydride group thereof or a polar group that is convertible into a carboxyl group reacted with the olefin copolymer; and/or wherein the ethylenically unsaturated carboxylic acid material is selected from acrylic acid, methacrylate acid, cinnamic acid, crotonic acid, maleic acid, fumaric acid or anhydride derivatives thereof.

[0006] In another approach or example, a lubricant composition is described herein. The lubricant composition includes a major amount of base oil of lubricating viscosity and a multi-functional olefin copolymer viscosity modifier. The multi-functional olefin copolymer viscosity modifier includes a reaction product of an acylated olefin copolymer and an amino mono- or di-carboxylic acid. The reaction product is optionally further reacted with an amine, ester, or

alcohol functionalization agent. The amino mono- or di-carboxylic acid has the formula H_2N-$R_1(R_2)$-COOH wherein R_1 is a C1 to C18 hydrocarbyl group and R_2 is hydrogen, a linear or branched alkyl group, an aryl group, a hydroxyphenyl group, a heterocyclic amino group, a carboxyl group, an amido group, an amino group, a hydroxyl group, a thiol, a thioester, selenium, or combinations thereof.

[0007] In yet further approaches or exanples, the lubricant composition of the previous paragraph can be combined with and/or include additional features that may be any of or any combination of the following: wherein the amine, ester, or alcohol functionalization agent is selected from aromatic amines, polyaromatic amines, primary amines, secondary amines, primary or secondary alcohols, napthyl alkyl amines, and mixtures thereof; and/or wherein the reaction product is formed in either the L or D isomeric form; and/or wherein the reaction product is either neutral or ionic; and/or wherein the acylated olefin copolymer includes an olefin copolymer having grafted thereon from 0.1 to 0.8 carboxylic groups per 1000 number average molecular weight units of the olefin copolymer; and/or wherein the olefin copolymer has a number average molecular weight between about 5,000 and about 200,000 as measured by GPC using polystyrene as reference; and/or wherein R_1 is a methylene group and R_2 is the heterocyclic amino group selected from an indole alkyl group or an imidazole alkyl group; and/or wherein the amino mono- or di-carboxylic acid is selected from amino hexanoic acid, 2-amino-3-phenyl propanoic acid, 2-amino-3-(1H-indol-3-yl) propanoic acid, 2-amino-3-(1H-imidazol-5-yl) propanoic acid, 2-amino butane dioic acid, 2-amino pentane dioic acid, 2-amino-4-methylpentanoic acid, and mixtures thereof; and/or wherein the reaction product is further reacted with the amine functionalization agent and wherein a primary or secondary amine thereof is capped with an oxazoline or derivative thereof; and/or wherein the oxazoline or derivative thereof is 2-phenyl-2-oxazoline; 2-ethyl-2 oxazoline; 2-methyl-2-oxazoline; 2-benzyl-4,4-dimethyl-2-oxazoline; 2-ethyl-4,4-dimethyl-2 oxazoline; 2,4,4-trimethyl-2-oxazoline; 4,4-dimethyl-2-oxazoline; 2,4,5-trimethyl-3-oxazoline; 2-(2,6-dimethoxyphenyl)-4,4-dimethyl-2-oxazoline; 2-[1-(hydroxymethyl)ethyl] oxazoline; mixtures thereof, or derivatives thereof; and/or wherein the reaction product is further reacted with the amine functionalization agent and wherein the amine functionalization agent is selected from N-arylphenylene-diamine, 1-(2-amino-ethyl)-imidazolidin-2-one, N-(3-aminopropyl) morpholine, 3-(dimethylamino)-1-propylamine, N-phenyl-p-phenylenediamine, N-(3-aminopropyl)-2 pyrrolidinone,

aminoethylacetamide, alanine methyl ester, 1-(3-aminopropyl) imidazole, polyetheramine, phenoxypropylamine, aromatic derivatives thereof, and combinations thereof and/or wherein the amine functionalization agent is an N-arylphenylene-diamine of the formula



wherein R_4 is hydrogen, --NH-aryl, --NH-arylalkyl, --NH-alkyl, or a branched or straight chain radical having from 4 to 24 carbon atoms that can be alkyl, alkenyl, alkoxyl aralkyl, alkaryl, hydroxyalkyl or aminoalkyl; R_5 is --NH_2, CH_2 --$(CH_2)_n$ --NH_2, or CH_2 -aryl-NH_2, in which n is an integer from 1 to 10; and R_6 is hydrogen, alkyl, alkenyl, alkoxyl, aralkyl, or alkaryl having from 4 to 24 carbon atoms; and/or wherein the N-arylphenylene-diamine is selected from N-phenyl-1,4-phenylenediamine; N-phenyl-1,3-phenylendiamine; N-phenyl-1,2-phenylenediamine; and mixtures thereof; and/or wherein the acylated olefin copolymer is derived from a copolymer of ethylene and one or more C3 to C18 alpha-olefins and a grafted ethylenically unsaturated carboxylic acid material having at least one ethylenic bond and at least one carboxylic acid group or anhydride group thereof or a polar group that is convertible into a carboxyl group reacted with the olefin copolymer; and/or wherein the ethylenically unsaturated carboxylic acid material is selected from acrylic acid, methacrylate acid, cinnamic acid, crotonic acid, maleic acid, fumaric acid or anhydride derivatives thereof.

[0008] In yet further approaches or examples, the present disclosure further describes uses of the multi-functional olefin copolymer lubricant additive or the lubricant composition of the previous paragraphs for lubricating a machine part or providing engine lubrication to minimize degradation of engine seals. Methods of lubricating machine parts or an engine using the above describes additives and compositions are also provided herein.

DETAILED DESCRIPTION

[0009] Engine or crankcase lubricant compositions are used in vehicles containing spark ignition and compression ignition engines. Such engines may be used in automotive, truck, and/or train applications, to suggest but a few examples, and may be operated on fuels including, but not limited to, gasoline, diesel, alcohol, compressed natural gas, and the like. The lubricants or lubricant compositions herein may be suitable for use as engine or crankcase lubricants, such

WHAT IS CLAIMED IS:

1. A multi-functional olefin copolymer lubricant additive comprising a reaction product of an acylated olefin copolymer and an amino mono- or di-carboxylic acid, the reaction product optionally further reacted with an amine, ester, or alcohol functionalization agent, and wherein the amino mono- or di-carboxylic acid has the formula

$H_2N\text{-}R_1(R_2)\text{-}COOH$

wherein

R_1 is a C1 to C18 hydrocarbyl group;

R_2 is hydrogen, a linear or branched alkyl group, an aryl group, a hydroxyphenyl group, a heterocyclic amino group, a carboxyl group, an amido group, an amino group, a hydroxyl group, a thiol, a thioester, selenium, or combinations thereof; and

wherein the acylated olefin copolymer is derived from a copolymer of ethylene and one or more C3 to C18 alpha-olefins and a grafted ethylenically unsaturated carboxylic acid material selected from acrylic acid, methacrylate acid, cinnamic acid, crotonic acid, maleic acid, fumaric acid or anhydride derivatives thereof.

2. The multi-functional olefin copolymer lubricant additive of claim 1, wherein the amine, ester, or alcohol functionalization agent is selected from aromatic amines, polyaromatic amines, primary amines, secondary amines, primary or secondary alcohols, napthyl alkyl amines, and mixtures thereof.

3. The multi-functional olefin copolymer lubricant additive according to any one of claims 1 to 2, wherein the reaction product is formed in either the L or D isomeric form; and/or wherein the reaction product is either neutral or ionic.

4. The multi-functional olefin copolymer lubricant additive according to any one of claims 1 to 3, wherein the acylated olefin copolymer includes an olefin copolymer having grafted thereon from 0.1 to 0.8 carboxylic groups per 1000 number average molecular weight units of the olefin copolymer; and/or wherein the olefin copolymer has a number average molecular weight between 5,000 and 200,000 as measured by GPC using polystyrene as reference.

5. The multi-functional olefin copolymer lubricant additive according to any one of claims 1 to 4, wherein R_1 is a methylene group and R_2 is the heterocyclic amino group selected from an indole alkyl group or an imidazole alkyl group.

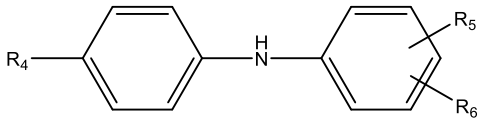
6. The multi-functional olefin copolymer lubricant additive according to any one of claims 1 to 5, wherein the amino mono- or di-carboxylic acid is selected from amino hexanoic acid, 2-amino-3-phenyl propanoic acid, 2-amino-3-(1H-indol-3-yl) propanoic acid, 2-amino-3-(1H-imidazol-5-yl) propanoic acid, 2-amino butane dioic acid, 2-amino pentane dioic acid, 2-amino-4-methylpentanoic acid, and mixtures thereof.

7. The multi-functional olefin copolymer lubricant additive according to any one of claims 1 to 6, wherein the reaction product is further reacted with the amine functionalization agent and wherein a primary or secondary amine thereof is capped with an oxazoline or derivative thereof.

8. The multi-functional olefin copolymer lubricant additive according to claim 7, wherein the oxazoline or derivative thereof is 2-phenyl-2-oxazoline; 2-ethyl-2 oxazoline; 2-methyl-2-oxazoline; 2-benzyl-4,4-dimethyl-2-oxazoline; 2-ethyl-4,4-dimethyl-2 oxazoline; 2,4,4-trimethyl-2-oxazoline; 4,4-dimethyl-2-oxazoline; 2,4,5-trimethyl-3-oxazoline; 2-(2,6-dimethoxyphenyl)-4,4-dimethyl-2-oxazoline; 2-[1-(hydroxymethyl)ethyl] oxazoline; mixtures thereof, or derivatives thereof.

9. The multi-functional olefin copolymer lubricant additive according to any one of claims 1 to 8, wherein the reaction product is further reacted with the amine functionalization agent and wherein the amine functionalization agent is selected from N-arylphenylene-diamine, 1-(2-amino-ethyl)-imidazolidin-2-one, N-(3-aminopropyl) morpholine, 3-(dimethylamino)-1-propylamine, N-phenyl-p-phenylenediamine, N-(3-aminopropyl)-2 pyrrolidinone, aminoethylacetamide, alanine methyl ester, 1-(3-aminopropyl) imidazole, polyetheramine, phenoxypropylamine, aromatic derivatives thereof, and combinations thereof.

10. The multi-functional olefin copolymer lubricant additive of claim 9, wherein the amine functionalization agent is an N-arylphenylene-diamine of the formula



wherein R_4 is hydrogen, --NH-aryl, --NH-arylalkyl, --NH-alkyl, or a branched or straight chain radical having from 4 to 24 carbon atoms that can be alkyl, alkenyl, alkoxyl aralkyl, alkaryl, hydroxyalkyl or aminoalkyl; R_5 is $--NH_2$, CH_2 $--(CH_2)_n$ $--NH_2$, or CH_2 -aryl-NH_2, in which n is an integer from 1 to 10; and R_6 is hydrogen, alkyl, alkenyl, alkoxyl, aralkyl, or alkaryl having from 4 to 24 carbon atoms.

11. The multi-functional olefin copolymer lubricant additive of claim 10, wherein the N-arylphenylene-diamine is selected from N-phenyl-1,4-phenylenediamine; N-phenyl-1,3-phenylendiamine; N-phenyl-1,2-phenylenediamine; and mixtures thereof.

12. The multi-functional olefin copolymer lubricant additive according to any one of claims 1 to 11, wherein the acylated olefin copolymer is derived from a copolymer of ethylene and one or more C3 to C18 alpha-olefins and a grafted ethylenically unsaturated carboxylic acid material having at least one ethylenic bond and at least one carboxylic acid group or anhydride group thereof or a polar group that is convertible into a carboxyl group reacted with the olefin copolymer.

13. The multi-functional olefin copolymer lubricant additive of claims 12, wherein the ethylenically unsaturated carboxylic acid material is selected from acrylic acid, methacrylate acid, cinnamic acid, crotonic acid, maleic acid, fumaric acid or anhydride derivatives thereof.

14. A lubricant composition comprising a major amount of base oil of lubricating viscosity and a multi-functional olefin copolymer viscosity modifier according to any one of claims 1 to 13.

15. Use of the multi-functional olefin copolymer lubricant additive according to any one of claims 1 to 13 in a lubricant composition for lubricating a machine part and to minimize degradation of seals.