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;

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; and

wherein the olefin copolymer has a number average molecular weight of 50,000 to 200,000 as measured by GPC using polystyrene as reference.

**[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

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;

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; and

wherein the olefin copolymer has a number average molecular weight of 50,000 to 200,000 as measured by GPC using polystyrene as reference.

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.

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.

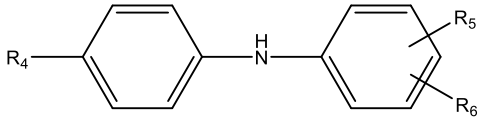
6. The multi-functional olefin copolymer lubricant additive according to any one of claims 1 to 5, wherein the amino mono- or di-carboxylic acid is selected from amino hexanoic acid, 2-amino-3-phenyl propanoic acid, 2-amino-3-(1H-indol-3-yl) propanoic acid, 2-amino-3-(1H-imidazol-5-yl) propanoic acid, 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. 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 11.

13. Use of the multi-functional olefin copolymer lubricant additive according to any one of claims 1 to 11 in a lubricant composition for lubricating a machine part and to minimize degradation of seals.