[05] Accordingly, there is a need for a dispersant or a dispersant combination that can provide satisfactory soot and/or sludge handling properties to a lubricant composition at a relatively low dispersant treat rate, as well as provide acceptable or improved thin film and/or boundary layer friction properties to an engine oil composition. Such lubricant compositions should be suitable for meeting or exceeding currently proposed and future lubricant performance standards.

SUMMARY AND TERMS

[05a] In a first aspect, the present disclosure refers to an engine oil composition comprising:

greater than 50% to about 99% by weight of a base oil, based on the total weight of the engine oil composition, and a dispersant that is a reaction product of A) a polyisobutenyl succinic acid or anhydride, and B) at least one polyamine, that is post-treated with C) an aromatic carboxylic acid, an aromatic polycarboxylic acid, or an aromatic anhydride, wherein all carboxylic acid or anhydride groups of C) are attached directly to an aromatic ring, and

wherein a molar ratio of carboxyl groups from components A) and C) to nitrogen atoms from component B) of from 0.9 to 1.3 is used to make the dispersant, the dispersant has a molar ratio of component C) to component B) of 0.6 to 2.0, component B) has an average of 4-6 nitrogen atoms per molecule, and a molar ratio of A) to B) is from 1.2 to 1.6; and

the engine oil composition comprises 0.25 wt.% to 5.5 wt.% of the dispersant, based on a total weight of the engine oil composition.

[05b] In another aspect, the present disclosure refers to a method for lubricating an engine comprising lubricating an engine with the engine oil composition as disclosed herein.

[05c] In yet another aspect, the present disclosure refers to a method for maintaining the soot or sludge handling capability of an engine oil composition comprising a step of adding to the engine oil composition a dispersant that is a reaction product of A) a polyisobutenyl succinic acid or anhydride, and B) at least one polyamine, that is post-treated with C) an aromatic carboxylic acid, an aromatic polycarboxylic acid, or an aromatic anhydride, wherein all carboxylic acid or anhydride groups of C) are attached directly to an aromatic ring, and

wherein a molar ratio of carboxyl groups from components A) and C) to nitrogen atoms from component B) of from 0.9 to 1.3 is used to make the dispersant, the dispersant

has a molar ratio of component C) to component B) of 0.6 to 2.0, component B) has an average of 4-6 nitrogen atoms per molecule, and a molar ratio of A) to B) is from 1.2 to 1.6; and

the engine oil composition comprises 0.25 wt.% to 5.5 wt.% of the dispersant, based on a total weight of the engine oil composition.

[05d] In a further aspect, the present disclosure refers to a method for improving boundary layer friction in an engine, comprising a step of lubricating the engine with the engine oil composition as disclosed herein.

[06] The present disclosure relates to engine oils including a dispersant, to methods of using these engine oils for lubricating an engine and uses of these dispersants and engine oils. In a first aspect, the disclosure relates to an engine oil composition including 50 wt.% to about 99 wt.% of a base oil, based on the total weight of the engine oil composition, and a dispersant that is a reaction product of A) a hydrocarbyl-dicarboxylic acid or anhydride and B) at least one polyamine, that is post-treated with C) an aromatic carboxylic acid, an aromatic polycarboxylic acid, or an aromatic anhydride. All carboxylic acid or anhydride groups of C) used for post-treatment are attached directly to an aromatic ring. The dispersant is made using a molar ratio of carboxyl groups from components A) and C) to nitrogen atoms from component B) of from 0.9 to 1.3, or from 1.0 to 1.3, a molar ratio of the moles of C) to moles of B) of at least 0.4, and when component B) has an average of 4-6 nitrogen atoms per molecule, the molar ratio of A) to B) is from 1.0 to 1.6. The engine oil composition comprises at least 0.1 wt.% of the dispersant, based on a total weight of the engine oil composition.

[07] In each of the foregoing embodiments, the molar ratio of carboxyl groups from components A) and C) to nitrogen atoms from component B) may be from 1.0 to 1.3.

[08] In each of the foregoing embodiments, C) may be a dicarboxyl-containing fused aromatic compound or anhydride thereof.

[09] In each of the foregoing embodiments, component C) may be 1,8-naphthalic anhydride.

[10] In each of the foregoing embodiments, when component B) has other than an average of 4-6 nitrogen atoms per molecule, the molar ratio of A) to B) may be from 1.0 to 2.0. or when component B) has an average of 4-6 nitrogen atoms per molecule, the molar ratio of A)

[203] Tests were run on lubricant compositions each containing a base oil and two dispersants, a dispersant as described in the table below and a constant amount of a second dispersant that was a polyisobutenyl-substituted succinic anhydride reacted with polyethylene amine. The following table sets forth the features of each dispersant combination tested for soot effective concentration in a lubricant composition. Figs. 2 and 3 are is a graphs showing the soot effective concentration for the lubricant compositions comprising the dispersant combinations set forth in Table 2.

Table 2

	Polyamine Component B) of the Dispersant	PIBSA/ Polyamine Molar Ratio	Moles of C)/ Moles of B)	CO/N*	Soot Effective Concentration Wt%
Comparative Dispersant 1	Mixture with an average of 5 nitrogen atoms	1.7	0.69	0.96	1.01
Comparative Dispersant 2	TEPA	3.0	0.5	1.4	2.16
Dispersant A	TETA	1.2	1.0	1.1	0.81
Dispersant B	TEPA	1.4	1.4	1.12	0.89
Dispersant C	TEPA	1.4	1.6	1.2	0.90
Dispersant D	TEPA	1.6	1.6	1.28	1.12
Dispersant E	TEPA	1.6	1.4	1.2	1.20
Dispersant F	TEPA	1.6	1.2	1.12	1.19
Dispersant G	TEPA	1.6	1.0	1.04	1.08
Dispersant H	TETA	1.6	0.4	1.0	0.92
Dispersant I	TETA	1.4	0.4	0.9	0.96
Dispersant J	TETA	1.4	0.6	1.0	0.85
Dispersant K	TETA	1.2	0.6	0.9	0.91
Dispersant L	TETA	1.2	0.8	1.0	0.840

*CO/N as used in Tables 2-6, is the molar ratio of carboxyl groups from components A) and C) charged to the reactor to the moles of nitrogen atoms delivered from component B) charged to the reactor to make the dispersant.

[204] The lower soot effective concentration provided by Dispersants A-C and Dispersants H-L relative to Comparative Dispersant 1 indicate that these dispersants provided improved soot dispersancy. Dispersants D-G provided acceptable soot dispersancy.

What is claimed is:

1. An engine oil composition comprising:

greater than 50% to about 99% by weight of a base oil, based on the total weight of the engine oil composition, and a dispersant that is a reaction product of A) a polyisobutenyl succinic ~~hydrocarbyl-dicarboxylic~~ acid or anhydride, and B) at least one polyamine, that is post-treated with C) an aromatic carboxylic acid, an aromatic polycarboxylic acid, or an aromatic anhydride, wherein all carboxylic acid or anhydride groups of C) are attached directly to an aromatic ring, ~~wherein the hydrocarbyl moiety of the hydrocarbyl-dicarboxylic acid or anhydride is a polyalkenyl substituent having a number average molecular weight of about 100 to about 5000 g/mol or is an ethylene-alpha olefin copolymer having a number average molecular weight of less than 5,000 g/mol,~~ and

wherein a molar ratio of carboxyl groups from components A) and C) to nitrogen atoms from component B) of from 0.9 to 1.3 is used to make the dispersant, the dispersant has a molar ratio of component C) to component B) of ~~at least 0.4~~0.6 to 2.0, ~~and when~~ component B) has an average of 4-6 nitrogen atoms per molecule, and a molar ratio of A) to B) is from 1.2~~0~~ to 1.6; and

the engine oil composition comprises ~~at least 0.1~~0.25 wt.% to 5.5 wt.% of the dispersant, based on a total weight of the engine oil composition.

2. The engine oil composition of claim 1, wherein the molar ratio of carboxyl groups from components A) and C) to nitrogen atoms from component B) is from 1.0 to 1.3.

3. The engine oil composition of claim 1, wherein component C) is 1,8-naphthalic anhydride.

~~4. The engine oil composition of claim 1, wherein when component B) has other than an average of 4-6 nitrogen atoms per molecule, the molar ratio of A) to B) is from 1.0 to 2.0.~~

~~5. The engine oil composition of claim 1, wherein when component B) has an average of 4-6 nitrogen atoms per molecule, the molar ratio of A) to B) is from 1.1 to 1.8 and when component B) has other than an average of 4-6 nitrogen atoms per molecule, the molar ratio of A) to B) is from 1.1 to 1.8.~~

~~6. The engine oil composition of claim 1, wherein the molar ratio of A) to B) is from 1.2 to 1.6.~~

~~7. The engine oil composition of claim 3, wherein a molar ratio of component C) to component B) is from 0.1:1 to 2.5:1.~~

~~8. The engine oil composition of claim 3, wherein a molar ratio of component C) to component B) is from 0.2:1 to 2:1.~~

~~9. The engine oil composition of claim 3, wherein a molar ratio of component C) to component B) is from 0.25:1 to 1.6:1.~~

~~10. The engine oil composition of claim 1, wherein the hydrocarbyl dicarboxylic acid or anhydride A) comprises a polyisobutenyl succinic acid or anhydride.~~

~~11. The engine oil composition of claim 10, wherein C) is a dicarboxyl-containing fused aromatic compound or anhydride thereof.~~

4~~12~~. The engine oil composition of claim 1, wherein the polyamine B) is selected from hexaethylene heptamine, pentaethylenehexamine, tetraethylenepentamine, triethylenetetramine, diethylenetriamine, ethylene diamine and mixtures containing two or more of these polyamines.

5~~13~~. The engine oil composition of claim 1, wherein the polyamine B) is tetraethylenepentamine.

6~~14~~. The engine oil composition of claim 1, wherein the dispersant is not post treated with a non-aromatic dicarboxylic acid or anhydride having a number average molecular weight of less than about 500 g/mol, as measured by GPC using polystyrene as a calibration reference.

~~15. The engine oil composition of claim 1, wherein component A) is a polyisobutenyl-substituted succinic anhydride and wherein the dispersant has a molar ratio of A) polyisobutenyl-substituted succinic anhydride to B) polyamine, in a range of from 1.0 to 2.2~~

~~except when component B) has an average of 4-6 nitrogen atoms per molecule, the molar ratio of A) to B) is from 1.0 to 1.6.~~

~~16. The engine oil composition of claim 1, wherein component A) is a polyisobutenyl-substituted succinic anhydride and wherein the dispersant has a molar ratio of A) polyisobutenyl-substituted succinic anhydride to B) polyamine, in a range of from 1.1 to 2.0 except when component B) has an average of 4-6 nitrogen atoms per molecule, the molar ratio of A) to B) is from 1.1 to 1.8.~~

~~17. The engine oil composition of claim 1, wherein component A) is a polyisobutenyl-substituted succinic anhydride and wherein the dispersant has a molar ratio of A) polyisobutenyl-substituted succinic anhydride to B) polyamine, in a range of from 1.2 to 1.6.~~

~~18. The engine oil composition of claim 1, wherein the amount of the dispersant derived from components A)-C) is 0.1-5.0 wt.%, based on a total weight of the engine oil composition.~~

~~19. The engine oil composition of claim 1, wherein the amount of the dispersant derived from components A)-C) is 0.25-3.0 wt.%, based on a total weight of the engine oil composition.~~

7~~20~~. The engine oil composition of claim 1, further comprising one or more of detergents, dispersants, friction modifiers, antioxidants, rust inhibitors, viscosity index improvers, emulsifiers, demulsifiers, corrosion inhibitors, antiwear agents, metal dihydrocarbyl dithiophosphates, ash-free amine phosphate salts, antifoam agents, and pour point depressants and any combination thereof.

8~~21~~. The engine oil composition of claim 1, comprising at least 1.0 wt.% soot.

9~~22~~. A method for lubricating an engine comprising lubricating an engine with the engine oil composition as claimed in claim 1.

10~~23~~. A method for maintaining the soot or sludge handling capability of an engine oil composition comprising a step of adding to the engine oil composition a dispersant that is a reaction product of A) a ~~hydrocarbyl-dicarboxylic~~ polyisobutenyl succinic acid or anhydride,

and B) at least one polyamine, that is post-treated with C) an aromatic carboxylic acid, an aromatic polycarboxylic acid, or an aromatic anhydride, wherein all carboxylic acid or anhydride groups of C) are attached directly to an aromatic ring, ~~wherein the hydrocarbyl moiety of the hydrocarbyl-dicarboxylic acid or anhydride is a polyalkenyl substituent having a number average molecular weight of about 100 to about 5000 g/mol or is an ethylene-alpha olefin copolymer having a number average molecular weight of less than 5,000 g/mol,~~ and

wherein a molar ratio of carboxyl groups from components A) and C) to nitrogen atoms from ~~the reaction product of A) and~~component B) of from 0.9 to 1.3 is used to make the dispersant, ~~and~~ the dispersant has a molar ratio of component C) to component B) of 0.6 to 2.0~~at least 0.4~~, component B) has an average of 4-6 nitrogen atoms per molecule, and a molar ratio of A) to B) is from 1.2 to 1.6; and

the engine oil composition comprises 0.25 wt.% to 5.5 ~~at least 0.1~~ wt.% of the dispersant, based on a total weight of the engine oil composition.

11~~24~~. A method for improving boundary layer friction in an engine, comprising a step of lubricating the engine with the engine oil composition as claimed in claim 1.

12~~25~~. The method of claim 11~~24~~, wherein the improvement in boundary layer friction is determined relative to a same composition in the absence of the dispersant.

13~~26~~. A method for improving thin film friction in an engine, comprising a step of lubricating the engine with the engine oil composition as claimed in claim 1.

14~~27~~. The method of claim 13~~26~~, wherein the improvement in thin film friction is determined relative to same composition in the absence of the dispersant.