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(54) Title:

**LUBRICANT COMPOSITION WITH LOW DEPOSITION
TENDENCY**

(57) Abstract:

- 1 1 - ABSTRACT OF THE DISCLOSURE LUBRICANT
COMPOSITION WITH LOW DEPOSITION TENDENCY
Lubricant base oil blends and finished lubricating compositions
having low deposition tendency are provided. The base oil
blends consist essentially of about 20 wt % to about 80 wt %,
based on the total weight of the blend, of an F-T Group III
base oil having less than 5 wt % cycloparaffins, the balance of
the blend being a Group III base oil having at least 35 wt %
cycloparaffins. The finished lubricating compositions comprise a
major amount of the base oil blend of the invention and at least
one engine oil additive.

ABSTRACT OF THE DISCLOSURE

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LUBRICANT COMPOSITION WITH LOW DEPOSITION TENDENCY

FIELD OF THE INVENTION

[001] The present invention relates to blended lubricant base oils useful in formulating engine oil lubricant compositions having low deposition and varnish-forming tendency.

BACKGROUND OF THE INVENTION

[002] Lubricating compositions for use in internal combustion engines typically comprise a base oil and a variety of additives to enhance the performance characteristics of the base oil. Important performance characteristics of a base oil include oxidation stability, additive solubility and deposit control. Because the base oil is the major constituent in these lubricating compositions, it contributes significantly to the properties of the finished lubricant. To produce high performance lubricating compositions, lubricant manufacturers are seeking base oils that have better performance characteristics than many petroleum derived base oils presently used in lubricating compositions. Thus, there is a trend toward using synthetic base oils such as polyalphaolefins (PAOs) that have better oxidation stability, for example, than petroleum derived base oils. PAO base oils are produced by a chemical polymerization process. Although PAOs exhibit good oxidation stability and deposit control, they have poor additive solubility and are expensive to produce. Fischer-Tropsch (F-T) derived lubricant base oils are desirable for their oxidation stability biodegradability and low levels of undesirable impurities, such as sulfur. Although F-T base oils are less expensive to produce than PAOs, F-T oils do not exhibit the same deposit control properties as PAOs. It would be useful, therefore, to provide a base oil comprising an F-T base oil that exhibits good deposit control.

SUMMARY OF THE INVENTION

[003] Accordingly, in one embodiment of the present invention, there is provided a lubricant base oil blend consisting essentially from about 20 wt % to about 80 wt %, based on the total weight of the blend, of an F-T Group III base oil containing less than 5 wt % cycloparaffins, the balance of the blend being a Group III base oil containing at least 35 wt % cycloparaffins. In another embodiment of the invention, there is provided an engine oil composition comprising: a major amount of a base oil blend consisting essentially of 20 wt % to about 80 wt % of an F-T Group III base oil having less than 5 wt % cycloparaffins and the balance being a Group III base oil having at least 30 wt % cycloparaffins; and at least one engine oil additive selected from dispersants, detergents, antiwear agents, VI improvers, antioxidants, defoamants, friction modifiers and rust inhibitors.

DETAILED DESCRIPTION OF THE INVENTION

[004] As is well known, the American Petroleum Institute has established a classification system for base oils (API Publication 1509, www.API.org). Group III oils are one of the five categories established by the API. The properties of all five categories are shown in Table 1.

Table 1

	Saturates	Sulfur	Viscosity Index
Group I	< 90% and/or	> 0.03% and	≥ 80 and < 120
Group II	≥ 90% and	≤ 0.03% and	≥ 80 and < 120
Group III	≥ 90% and	≤ 0.03% and	≥ 120
Group IV	Polyalphaolefins (PAO)		
Group V	All other base oil stocks not included in Groups I, II, III, or IV		

[005] The F-T Group III oils used in the present invention are derived from synthesis gas in the F-T hydrocarbon synthesis process. The other Group III oils used in the base oil blends of the invention may be derived from natural petroleum base stocks.

[006] The F-T Group III oils used in the base oil blends are characterized as having less than 5 wt % cycloparaffins, for example, from about 0.5 wt % to about 4.75 wt % where the mono to cycloparaffins ratio is 10/1 or greater. Typically, the F-T Group III oil will have a kinematic viscosity in the range of about 2.0 to 8.0 mm²/s at 100°C and preferably in the range of about 3.5 to 6.5 at 100°C.

[007] The F-T Group III oils used in the present invention have predominantly paraffinic components. Preferably, the F-T Group III oils have less than 0.1 wt % aromatic hydrocarbons, less than 20 wppm nitrogen-containing compounds and less than 20 wppm sulfur-containing compounds. These F-T oils typically have an initial boiling point of about 345°C. The F-T Group III oils used in the invention have a pour point lower than -18°C preferably lower than -21°C.

[008] The F-T Group III oils are prepared by catalytically converting a synthesis gas comprising a mixture of H₂ and CO into hydrocarbons, usually waxy hydrocarbons (referred to as F-T wax). The F-T wax is then converted to lower boiling material by processes comprising hydroisomerization and hydrotreating. These processes are all well known by persons of ordinary skill in the art.

[009] The process of making a lubricant F-T Group III base oil from an

F-T wax may include preliminary treatment to remove oxygenates. Treatment to remove any sulfur and nitrogen compounds is not normally needed because F-T waxes have only trace amounts of sulfur or nitrogen.

[010] Particularly favorable processes that can be used for the production of F-T Group III oils are described in US Patents 4,594,172; 4,943,672; 6,046,940; 6,475,960; 6,103,099; 6,332,974 and 6,375,830, all incorporated herein by reference.

[011] The base oil blend of the invention consists essentially of from about 20 wt % to about 80 wt %, preferably from 30 wt % to 80 wt % and more preferably 50 wt % to 80 wt % of an F-T Group III oil having less than 5 wt % cycloparaffins.

[012] The balance (i.e., about 80 wt % to about 20 wt %) of the base oil blend of the invention consists of a Group III oil having at least 35 wt % cycloparaffins, preferably from 40 wt % to about 50 wt % and more preferably from about 44 wt % to 50 wt %. Such Group III oils typically are derived from natural petroleum base stocks and are commercially available materials. Typically, they will have a kinematic viscosity in the range of about 3.5 mm²/s to about 6.5 mm²/s at 100°C. These Group III oils will have a nominal initial boiling point of about 365°C and a pour point lower than -18°C and preferably lower than -21°C.

[013] The base oil blends of the invention are particularly suitable for use in preparing lubricating oils for internal combustion engines. They may be formulated to have a single viscosity grade, such as SAE 30. Preferably, the base oil blends are formulated with VI improvers that provide the composition with a

multi-viscosity grade such as 5W30 and 5W40 grades. Thus, one embodiment of the invention provides an engine oil lubricating composition comprising: a major amount of a base oil blend consisting essentially of 20 wt % to about 80 wt % of an F-T Group III base oil having less than 5 wt % cycloparaffins and the balance being a Group III base oil having at least 30 wt % cycloparaffins; and

at least one engine oil additive selected from dispersants, detergents, antiwear agents, VI improvers, antioxidants, defoamants, friction modifiers and rust inhibitors.

[014] Suitable dispersants include succinimide dispersants, ester dispersants, ester-amide dispersants, and the like. Preferably, the dispersant is a succinimide dispersant, especially a polybutenyl succinimide. The molecular weight of the polybutenyl group may range from about 800 to about 4000 or more and preferably from about 1300 to about 2500. The dispersant may be head capped or borated or both.

[015] Examples of useful detergents are the alkali and alkaline earth metal salicylates, alkylsalicylates, phenates and sulfonates.

[016] A commonly used class of antiwear additives is zinc dialkyldithiophosphates in which the alkyl groups typically have from 3 to about 18 carbon atoms with 3 to 10 carbon atoms being preferred.

Suitable VI improvers include linear or radial styrene-isoprene VI improvers, olefin copolymers, polymethacrylates, and the like. Examples of suitable antioxidants include aminic antioxidants and phenolic antioxidants. Typical aminic antioxidants include alkylated aromatic amines, especially those in which the alkyl group contains no more than 14 carbon atoms. Typical phenolic antioxidants include derivatives of dihydroxy aryl compounds in which the

hydroxyl groups are in the o- or p- position to each other and which contain alkyl substituents. Mixtures of phenolic and aminic antioxidants also may be used. Such antioxidant(s) may be used in an amount of about 0.02 to 5 wt % and preferably about 0.1 wt % to about 2 wt % based on the total weight of the composition.

[017] Suitable antifoam additives include silicone oils or polysiloxane oils usually used in amounts of from 0.0001 to 0.01 wt % active ingredient. Pour point depressants are well known lubricant additives. Typical examples are dialkylfumarates, polyalkylmethacrylates, and the like.

[018] The number and types of friction modifiers are voluminous. In general, they include metal salts of fatty acids, glycerol esters and alkoxylated fatty amines to mention a few.

[019] Rust inhibitors selected from the group consisting of nonionic polyoxyalkylene polyols and esters thereof, polyoxyalkylene phenols and aminic alkyl sulfonic acids may be used.

[020] In general, on an active ingredient basis, the various lubricant additives will comprise from about 0.5 wt % to about 25 wt % and preferably from about 2 wt % to about 10 wt % based on the total weight of the composition.

Examples

[021] A series of oils were formulated using the base oils and base oil blends shown in Table 2. The cycloparaffin content shown in Table 2 was determined by the Brandes Infra Red Method (see Brandes G., *Brennstoff-Chem*, 37, 1956, pages 263-267).

[022] Each formulation contained the same commercially available additive package (adpack). The adpack contained a non-borated PIB succinimide dispersant, calcium and magnesium detergent, zinc alkyldithiophosphate antiwear agent, and a polydimethylsilicone antifoamant.

[023] The oils were formulated to a target kinematic viscosity at 100°C of about 14 mm²/s.

[024] The deposit tendency of each of the formulated oils was determined by the MHT-4 test, ASTM D7097. The results of the test are given in Table 2.

Table 2

	Oil 1	Oil 2	Oil 3	Oil 4	Oil 5	Oil 6	Oil 7
	5W-40	5W-40	5W-40	5W-40	5W-40	5W-40	5W-40
Base Oil , wt%							
F-T III	67.2				47.9	46.2	47.8
Group III - Source A		67.2			19.6		
Group III - Source B			67.2			21.3	
PAO				67.2			19.7
Adpack, wt%	13.8	13.8	13.8	13.8	13.7	13.7	13.7
VI Improver, wt% (1)	19.0	19.0	19.0	19.0	18.8	18.8	18.8
Cycloparaffins, wt%	4.7	31.0	44.4	4.7	9.8	13.2	4.7
Properties							
KV @ 40°C, mm ² /s	79.4	82.4	92.6	83.4	79.3	83.5	80.2
KV @ 100°C, mm ² /s	14.0	14.3	15.0	13.9	14.1	14.5	14.1
MTH-4, Deposits, mg	75.8	50.3	48.4	39.4	83.7	58.9	79.9
Calc. MHT-4 Deposits, mg	-	-	-	-	68.7	67.5	65.5

1) 6 wt% in mineral oil.

Source A = Visom

Source B = Yubase

[025] The results in Table 2 show that Oil 6 of this invention gave unexpectedly lower deposits than the calculated GTL and PAO base oils combination (Oil 7). The results could not be predicted since Oil 7 was expected to give the lowest deposits.

[026] For each of Oils 5, 6 and 7, the amount of deposits that could be expected was calculated using the MTH-4 deposits produced by each oil and the ratio of the base oils used in the blends. A comparison of the calculated results with the actual results shows that the deposit-forming tendency is not predictable. Also, the results show that Oil 6 of the invention gave unexpectedly lower deposits than Oil 7, which would be expected to give lower deposits.

CLAIMS:

1. A lubricating base oil blend consisting essentially of from about 20 wt % to about 80 wt %, based on the total weight of the blend, of an F-T Group III base oil having less than 5 wt % cycloparaffins, the balance being a Group III base oil having at least 35 wt % cycloparaffins.

2. The blend of Claim 1 wherein the F-T Group III base oil comprises 30 wt % to 80 wt % of the blend.

3. The blend of Claim 2 wherein the F-T Group III base oil comprises 50 wt % to 80 wt % of the blend.

4. The blend of Claim 3 wherein the Group III base oil has from 40 wt % to 50 wt % of cycloparaffins.

5. The blend of Claim 4 wherein the Group III base oil has from about 44 wt % to about 50 wt % of cycloparaffins.

6. A lubricating oil composition comprising:
a major amount of a base oil blend consisting essentially of about 20 wt % to about 80 wt %, based on the total weight of the blend, of an F-T Group III base oil having less than 5 wt % cycloparaffins, the balance of the blend being a Group III base oil having at least 35 wt % cycloparaffins, and
at least one engine oil additive selected from dispersants, detergents, antiwear agents, VI improvers, antioxidants, defoamants, friction modifiers and rust inhibitors.

7. The composition of Claim 6 wherein the F-T Group III base oil comprises 30 wt % to 80 wt % of the blend.

8. The composition of Claim 7 wherein the F-T Group III base oil comprises 50 wt % to 80 wt % of the blend.

9. The composition of Claim 8 wherein the Group III base oil has from about 40 wt % to about 50 wt % of cycloparaffins.

10. A method for improving the deposit control as measured by test MTH-4 (ASTM D7097) of a fully formulated engine oil comprising an F-T Group III base oil having less than 5 wt % cycloparaffins, the method comprising blending the F-T Group III base oil with a sufficient amount of a Group III base oil having at least 35 wt % cycloparaffins to provide the blend with from about 20 wt % to about 80 wt %, based on the total weight of the blend, of the F-T Group III oil.

11. The method of Claim 10 wherein the Group III base oil has from about 40 wt % to about 50 wt % of cycloparaffins.

12. The method of Claim 11 wherein the amount of Group III oil is sufficient to provide a blend with from 30 wt % to 80 wt % of the F-T Group III base oil.

13. Use of the base oil blend of any one of Claims 1 to 5 as the base oil in a fully formulated engine oil.