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(54) **Lubricating composition**

(57) A lubricating composition comprising (i) a Fischer-Tropsoh derived base oil, and (ii) lubricant additive at a total level of at most 2% by weight, wherein the lubricating composition has a viscosity index of at least 140 and a kinematic viscosity at 40°c of at most 100 mm^2/s, and wherein the lubricating composition is essentially free of polymeric viscosity index improver. The lubricating composition of the invention exhibits improved extreme pressure and shear stability properties.

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Description

Field of the Invention

[0001] The present invention relates to a lubricating composition, and hydraulic fluids comprising the lubricating composition.

Background of the Invention

[0002] Lubricating oil compositions are widely used as hydraulic fluids in e.g. manufacturing, construction and transportation.

[0003] High viscosity index (VI) is required for hydraulic oils dedicated to mobile or stationary equipment that is subjected to outside temperatures or which is particularly sensitive to temperature changes. Oil that has a high VI shows less variation in viscosity with temperature, i.e. it remains viscous enough to act as an effective lubricant at the highest temperatures and fluid enough at low temperatures to be pumpable.

[0004] In formulating a "multigrade" hydraulic fluid, i.e. a fluid with a relatively high viscosity index (VI), (e.g. > 140) which can be used in equipment where operating temperatures can vary significantly, the formulator can obtain the desired VI by proper selection of type and amounts of the base oil and VI improver.

[0005] API Group I mineral oils commonly have a viscosity index of 90-100. Other types of base oils such as poly-alpha-olefin (PAOs) and esters may have a VI about 135 and 160 respectively.

[0006] "VI improvers", "VI modifiers" or "thickening agents" have traditionally been used to increase the VI of the intended composition. Examples of viscosity index improvers include non-dispersant-type viscosity index improvers such as polymethacrylates and olefin copolymers such as ethylene/propylene copolymer and styrene/diene copolymer, and dispersion-type viscosity index improvers such as those obtained by copolymerizing these with nitrogen-containing monomers. The thickening or VI adding power of a VI modifier usually increases with its molecular weight. However, with increasing molecular weight of the VI improver shear stability decreases. "Shear stability" is the tendency of the large (usually polymer) molecules to be degraded during use as they pass around the hydraulic system.

[0007] Therefore, the formulator needs to carefully select the base oil (or base oil mixture), thickening power and shear stability in order to formulate a composition that meets the desired targets.

[0008] It would be desirable to formulate a high viscosity index lubricating composition having improved shear stability.

[0009] It would also be desirable to formulate a high viscosity index lubricating composition wherein the need for viscosity improvers is eliminated.

[0010] It would further be desirable to formulate a lubricating composition having improved extreme pressure and anti-wear properties.

[0011] It has now surprisingly been found that these and other benefits can be achieved through the use of a lubricating composition comprising a Fischer-Tropsch derived base oil.

Summary of the Invention

[0012] According to the present invention there is provided a lubricating composition comprising (i) a Fischer-Tropsch derived base oil, and (ii) lubricant additive at a total level of at most 2% by weight, wherein the lubricating composition has a viscosity index of at least 140 and a kinematic viscosity at 40°C of at most 100 mm^2/s, and wherein the lubricating composition is essentially free of polymeric viscosity index improver.

[0013] It has surprisingly been found that the compositions of the present invention have a high viscosity index without the need for polymeric viscosity improvers. It has also surprisingly been found that the compositions of the present invention have improved shear stability and extreme pressure properties.

[0014] According to a further aspect of the present invention there is provided the use of a Fischer-Tropsch derived base oil for improving the anti-wear performance of a lubricating composition, the lubricating composition comprising (i) a Fischer-Tropsch derived base oil, and (ii) lubricant additive at a total level of at most 2% by weight, wherein the lubricating composition has a viscosity index of at least 140 and a kinematic viscosity at 40°C of at most 100 mm^2/s, and wherein the lubricating composition is essentially free of polymeric viscosity index improver.

[0015] According to yet a further aspect of the present invention there is provided the use of a Fischer-Tropsch derived base oil for improving the shear stability of a lubricating composition, the lubricating composition comprising (i) a Fischer-Tropsch derived base oil, and (ii) lubricant additive at a total level of at most 2% by weight, wherein the lubricating composition has a viscosity index of at least 140 and a kinematic viscosity at 40°C of at most 100 mm^2/s, and wherein the lubricating composition is essentially free of polymeric viscosity index improver.

Detailed Description of the Invention

[0016] The lubricating composition of the present invention has a Viscosity Index (according to ASTM D2280) of at least 140. In one embodiment, the lubricating composition has a Viscosity Index of at least 160. In another embodiment the lubricating composition has a Viscosity Index of at least 180.

[0017] The lubricating composition of the present invention has a kinematic viscosity at 40°C (according to ASTM D445) of at most 100 mm^2/s. In one embodiment of the present invention, the lubricating composition has a kinematic viscosity at 40°C of 32 mm^2/s (i.e. ISO 32). In another embodiment of the present invention, the lubricating composition has a kinematic viscosity at 40°C of 46 mm^2/s (i.e. ISO 46). In a further embodiment of the present invention, the lubricating composition has a kinematic viscosity at 40°C of 68 mm^2/s (i.e. ISO 68). In yet a further embodiment of the present invention, the lubricating composition herein has a kinematic viscosity at 40°C of 100 mm^2/s (i.e. ISO 100).

[0018] The lubricating composition of the present invention comprises a Fischer-Tropsch derived base oil. The Fischer-Tropsch derived base oil is preferably present at a level in the range of from 80% to 99.5%, more preferably at a level in the range of from 90% to 99.5%, even more preferably at a level in the range of from 98% to 99.5%, by weight of the lubricating composition.

[0019] Fischer-Tropsch derived base oils are known in the art. By the term "Fischer-Tropsch derived" is meant that a base oil is, or is derived from, a synthesis product of a Fischer-Tropsch process. A Fischer-Tropsch derived base oil may also be referred to as a GTL (Gas-To-Liquids) base oil. Suitable Fischer-Tropsch derived base oils that may be conveniently used as the base oil in the lubricating composition are those as for example disclosed in EP 0 776 959, EP 0 668 342, WO 97/21788, WO 00/15736, WO 00/14188, WO 00/14187, WO 00/14183, WO 00/14179, WO 00/08115, WO 99/41332, EP 1 029 029, WO 01/18156 and WO 01/57166.

[0020] The Fischer-Tropsch derived base oil for use herein preferably has a kinematic viscosity (according to ASTM D445) at 100°C in the range of from 4 mm^2/s to 20 mm^2/s, more preferably in the range of from 4 mm^2/s to 10 mm^2/s. Mixtures of two or more Fischer-Tropsch derived base oils may also be used herein.

[0021] In one embodiment of the present invention, the Fischer-Tropsch derived base oil for use herein has a kinematic viscosity at 100°C in the range of from 4 to 6 mm^2/s .

[0022] In another embodiment of the present invention, the Fischer-Tropsch derived base oil for use herein has a kinematic viscosity at 100°C in the range of from 7 to 9 mm^2/s.

[0023] In a preferred embodiment of the present invention, the Fischer-Tropsch derived base oil is a mixture of two Fischer-Tropsch derived base oils, one having a kinematic viscosity at 100°C in the range of from 4 to 6 mm^2/s and the other having a kinematic viscosity at 100°C in the range of from 7 to 9 mm^2/s.

[0024] The lubricating composition of the present invention eliminates the need for high levels of polymeric viscosity improvers and are essentially free of polymeric viscosity improvers. Examples of polymeric viscosity index improvers include non-dispersant-type viscosity index improvers such as polymethacrylates and olefin copolymers such as ethylene/propylene copolymer and styrene/diene copolymer, and dispersion-type viscosity index improvers such as those obtained by copolymerizing these with nitrogen-containing monomers. By the term "essentially free of polymeric viscosity improvers" as used herein means that the concentration of dry polymer viscosity improvers is preferably less than 0.1%, by weight of the lubricating composition. In a particularly preferred embodiment, the lubricating composition of the present invention is free of polymeric viscosity improvers, i.e. the lubricating composition comprises 0% by weight of polymeric viscosity improvers.

[0025] The lubricating composition of the present invention may also contain one or more further base oils in addition to the Fischer-Tropsch derived base oil. The one or more further base oils may be selected from Group I-V base oils which, together with the Fischer-Tropsch derived base oil and the lubricant additive, provides a Viscosity Index for the lubricating composition of at least 140.

[0026] By "Group I-V" base oils in the present invention are meant lubricating oil base oils according to the definitions of American Petroleum Institute (API) categories I-V. Such API categories are defined in API Publication 1509, 15th Edition, Appendix E, April 2002.

[0027] Examples of suitable base oils which may be used herein in addition to the Fischer-Tropsch derived base oil include Group IV base oils such as heavier PAO's (e.g. PAO 8 and upwards) and Group III wax isomerates such as those base oils commercially available from Shell under the tradename "XHVI".

[0028] In a particularly preferred embodiment herein the lubricating composition does not contain further base oils in addition to the Fischer-Tropsch derived base oil.

[0029] The lubricating oil composition of the present invention further comprises one or more additives such as anti-wear additives, anti-oxidants, corrosion inhibitors, anti-foam agents, demulsifiers, pour point depressants, and mixtures thereof. The amount of said additives present in the lubricating composition depends on the specific compounds used. As the above-mentioned and other additives are well known in the art, they are not described herein in full detail. The total amount added of the additives is at most 2 wt%, preferably at most 1 wt%, more preferably at most 0.75 wt%, by weight of the lubricating composition. The total amount of additives present in the lubricating composition is preferably

at least 0.5 wt%, more preferably at least 0.6 wt%, relative to the weight of the lubricating composition.

[0030] Examples of anti-wear additives are zinc-based or zinc-free or ashless anti-wear additives.

[0031] Examples of corrosion inhibitors are N-alkylsarcosinic acids, alkylate phenoxy acetates, imidazolines, the alkaline earth metal salts of phosphate esters disclosed in EP 0 801 116 and alkenyl succinate ester-based corrosion inhibitors.

[0032] Examples of anti-oxidants are amine-based, sulphur based, phenol-based and phosphorus-based anti-oxidants. These antioxidants can be used individually, or a plurality can be used in combination.

[0033] Examples of foam inhibitors are organo-silicates such as dimethylpolysiloxane, diethyl silicate and fluorosilicone, and non-silicone foam inhibitors such as polyalkyl acrylates.

[0034] Examples of demulsifiers are polyalkylene glycol-based nonionic surfactants such as polyoxyethylene alkyl ethers, polyoxyethylene alkyl phenyl ethers and polyoxyethylene alkyl naphthyl ethers.

[0035] Examples of pour-point depressants are polymethacrylate-based polymers.

[0036] The lubricating oil composition according to the present invention can be conveniently prepared by blending together one or more base oils, and one or more lubricant additives.

[0037] The lubricating composition is especially useful for formulating hydraulic fluid compositions. Hence according to the present invention there is provided a hydraulic fluid composition comprising the lubricating composition described herein.

[0038] The present invention also relates to the use of a Fischer-Tropsch derived base oil for improving the extreme pressure properties of a lubricating composition.

[0039] The present invention further relates to the use of a Fischer-Tropsch derived base oil for improving the shear stability properties of a lubricating composition.

[0040] The present invention is described below with reference to the following Examples, which are not intended to limit the scope of the invention in any way.

Examples

Example 1 and Comparative Example 1

[0041] Lubricating oil compositions were prepared by blending base oil and additives in the amounts as shown in Table 2 below. The base oil in Comparative Example 1 was mineral oil. The base oil in Example 1 was a mixture two GTL base oils having kinematic viscosities of 5.1 cSt (GTL 5.1) and 7.7 cSt (GTL 7.7) at 100°c. The physical characteristics of the two GTL base oils are displayed in Table 1 below. The GTL base oils can be prepared according to the method described in WO2004/07647.

Table 1

Characteristic	Test Method	Units	GTL 5.1	GTL 7.7
Vk at 100°C	ISO 3104	mm^2/s	5.143	7.77
Vk at 40°C	ISO 3104	mm^2/s	24.52	43.88
Viscosity Index	ISO 2909		144	148
Vd at -30°c	ASTM D5293	cP	1860	5323
Vd at -35 °C	ASTM D5293	cP	3162	9830
Digital Density at 15°C	IP365/97	Kg/m^3	820.7	827.5
NOACK	CEC L-40-A-93	%w	8.95	2.3
Pour Point	ISO 3016	°C	-24	-24
Colour	ASTM D1500		0	L 1.0
Appearance			Clear and bright, water white	Clear and bright, pale brown

Table 2

Component	Example 1 (wt%)	Comparative Example 1 (wt%)
GTL 5.1	balance	0

(continued)

Component	Example 1 (wt%)	Comparative Example 1 (wt%)
GTL 7.7	47.1	0
Mineral oil HVI 60[1]	0	91.4
Mineral Oil HVI 160B[2]	0	balance
Performance Additive Package[3]	0.75	0.75
Pour Point Depressant	0.15	0.15
Anti-Foam agent	0.0125	0.0125
Viscosity Modifier	0	4.7

1. API Group I Mineral Oil commercially available from Shell Netherlands B.V. (ex. Pernis refinery) having a Vk100 of 4.4-4.9 mm2/s
2. API Group I Mineral Oil commercially available from Shell Netherlands B.V. (ex. Pernis refinery) having a Vk100 of 10.7-11.8 cSt)
3. Performance Additive Package containing anti-wear additive, anti-oxidant, corrosion inhibitor and demulsifier

[0042] In order to measure their extreme pressure properties, the lubricating compositions were subjected to an FZG Stage Failure Test according to CEC L-07-A-952. The Shear Stability of the compositions was also determined according to CEC L-45-A-99. The results of these tests are shown in Table 3 below.

Table 3

Characteristic	Example 1	Comparative Example 1
Vk at 40°C	32.55 (mm^2/s)	33.53 (mm^2/s)
Vk at 100°c	6.275 (mm^2/s)	6.402 (mm^2/s)
VI	146	145
FZG Damage Load Stage	12F	8F
Shear Stability: Change in Vk 100	< 0.1 (%)	11.0 (%)

[0043] As can be seen from Table 3, Example 1 exhibits a high Viscosity Index (VI = 146) despite containing no Viscosity Modifier. Further, Example 1 exhibits a higher FZG load stage than Comparative Example 1 demonstrating that Example 1 (containing a GTL base oil) has better extreme wear properties than Comparative Example 1 (containing a mineral oil base oil). In addition, Example 1 exhibits better shear stability characteristics than Comparative Example 1.

Claims

1. Lubricating composition comprising (i) a Fischer-Tropsch derived base oil, and (ii) lubricant additive at a total level of at most 2% by weight, wherein the lubricating composition has a viscosity index of at least 140 and a kinematic viscosity at 40°C of at most 100 mm^2/s, and wherein the lubricating composition is essentially free of polymeric viscosity index improver.

2. Lubricating composition according to Claim 1 wherein the lubricant additive is present at a total level of at most 1% by weight.

3. Lubricating composition according to Claim 1 or 2 wherein the lubricant additive is present at a total level of at most 0.75% by weight.

4. Lubricating composition according to any of Claims 1. to 3 wherein the lubricating composition is free of polymeric viscosity index improver.

5. Lubricating composition according to any of Claims 1 to 4 wherein the Fischer-Tropsch derived base oil has a kinematic viscosity at 100°C in the range of 4 mm^2/s to 20 mm^2/s .

6. Lubricating composition according to any of Claims 1 to 5 wherein the Fischer-Tropsch derived base oil has a kinematic viscosity at 100°C in the range of from 4 mm^2/s to 10 mm^2/s.

7. Lubricating composition according to any of Claims 1 to 6 wherein the lubricant additive is selected from anti-wear additives, anti-oxidants, corrosion inhibitors, anti-foam agents, demulsifiers, pour point depressants, and mixtures thereof.

8. Hydraulic Fluid comprising the lubricating composition according to any of Claims 1 to 10.

9. Use of a Fischer-Tropsch derived base oil for improving the anti-wear performance of a lubricating composition, the lubricating composition comprising (i) a Fischer-Tropsch derived base oil, and (ii) lubricant additive at a total level of at most 2% by weight, wherein the lubricating composition has a viscosity index of at least 140 and a kinematic viscosity at 40°C of at most 100 mm^2/s, and wherein the lubricating composition is essentially free of polymeric viscosity index improver.

10. Use of a Fischer-Tropsch derived base oil for improving the shear stability of a lubricating composition, the lubricating composition comprising (i) a Fischer-Tropsch derived base oil, and (ii) lubricant additive at a total level of at most 2% by weight, wherein the lubricating composition has a viscosity index of at least 140 and a kinematic viscosity at 40°C of at most 100 mm^2/s, and wherein the lubricating composition is essentially free of polymeric viscosity index improver.

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EUROPEAN SEARCH REPORT

Application Number
EP 10 16 1712

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 2006/135376 A1 (HABEEB JACOB J [US] ET AL HABEEB JACOB JOSEPH [US] ET AL) 22 June 2006 (2006-06-22) * paragraphs [0003], [0081], [0082], [0087]; tables 1,3 *	1-9 10	INV. C10M171/02 ADD. C10N30/02 C10N30/06
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Y A	US 2004/154957 A1 (KEENEY ANGELA J [GB] ET AL) 12 August 2004 (2004-08-12) * paragraph [0185] - paragraph [0190]; table 5 *	10 1-9	
A	US 2009/005273 A1 (SWARTELE CHANTAL R [BE] ET AL) 1 January 2009 (2009-01-01) * paragraph [0149] - paragraph [0150]; claims; table IV *	1-10	

TECHNICAL FIELDS SEARCHED (IPC)

C10M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	5 November 2010	Glod, Guy

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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L : document cited for other reasons

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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- Appendix E. API Publication 1509, April 2002 **[0026]**