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(54) **USE OF A BASE OIL IN A LUBRICATING OIL FOR IMPROVING THE AIR RELEASE IN A HYDRAULIC SYSTEM**

VERWENDUNG EINES GRUNDÖLS IN EINEM SCHMIERÖL ZUR VERBESSERUNG DER LUFTFREISETZUNG IN EINEM HYDRAULISCHEN SYSTEM

UTILISATION D'UNE HUILE DE BASE DANS UNE HUILE LUBRIFIANTE POUR AMÉLIORER LA LIBÉRATION D'AIR DANS UN SYSTÈME HYDRAULIQUE

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DescriptionField of the Invention

5 **[0001]** The invention relates to a use for improving the air release of a lubricating oil in a hydraulic system.

Background of the Invention

10 **[0002]** Lubricating oils are required in hydraulic systems to protect, lubricate and help transmit power. Current trends in the design of hydraulic systems are towards smaller reservoirs, low oil residence times and high power output. These changes are leading to increased problems of air entrainment. Air entrainment is a phenomenon wherein air bubbles (typically having a diameter of less than 1mm) are dispersed throughout the lubricating oil. Entrained air can be distinguished from free air (a pocket of air trapped in part of the system), from dissolved air (lubricating oils may contain between 6 and 12 percent by volume of dissolved air) and from foam (air bubbles typically greater than 1mm in diameter that congregate on the surface of the oil). Air entrainment can have a number of negative consequences including loss of lubricity, possible oxidation of the lubricating oil, noisy operation, lower efficiency and higher oil temperatures.

15 **[0003]** The air entrainment properties of a lubricating oil are typically measured using the ASTM D3427 air release test. This test measures the time needed for air entrained in the oil to reduce in volume to 0.2% under the test conditions and at the specified temperature.

20 **[0004]** US 2006/131210 A discloses a hydraulic oil, comprising: a. a lubricant base oil having: i. an average molecular weight greater than 475; ii. a viscosity index greater than 140; iii. a weight percent olefins less than 10; and b. an antiwear hydraulic oil additive package; wherein the hydraulic oil has: i. an air release by ASTM D 3427-03 of less than 0.8 minutes at 50°C., and ii. a sequence II foam tendency by ASTM D 892-03 of less than 50 ml. In the hydraulic oil, the lubricant base oil may be Fischer-Tropsch derived. US 2008/096779 A discloses a turbine oil composition comprising an admixture of: (a) a major amount of at least an isomerized base oil having consecutive numbers of carbon atoms and has less than 25 wt % naphthenic carbon by n-d-M; and (b) a minor amount of one or more standard turbine oil additive packages; wherein the turbine oil composition has a viscosity index of greater than about 150. The isomerized base oil may be a Fischer-Tropsch derived base oil made from a waxy feed. WO 2009/115502 A discloses a lubricating composition comprising a base oil and one or more additives, wherein the composition has a heat capacity (according to ASTM E 1269) at 90°C of above 2.25 J/g°C. The composition may comprise at least 30 wt.% of a base oil selected from the group consisting of a poly-alphaolefin base oil and a Fischer-Tropsch derived base oil or a combination thereof. The lubricating composition may have an air release of at most 2.0 minutes according to IP 313. The lubricating composition may be used as a hydraulic oil.

25 **[0005]** The present inventors have sought to improve the air entrainment properties of lubricating oils that are used in hydraulic systems.

Summary of the Invention

30 **[0006]** Accordingly, the invention provides a use, in a lubricating oil comprising at least 90% by mass, based upon the mass of the lubricating oil, of base oil wherein the base oil comprises at least 10% by mass of a base oil chosen from Group I, Group II or Group III, of at least 70% by mass, based upon the mass of the base oil, of GTL base oil to improve the air release of a lubricating oil in a hydraulic system, wherein the viscosity of the GTL base oil at 100°C is from 2 to 20cSt; wherein the lubricating oil comprises less than 10% by mass, based upon the mass of the lubricating oil, of additives; wherein the viscosity of the lubricating oil at 40°C is from 20 to 100cSt; and wherein air release is measured according to ASTM D3427 and is improved as compared to air release achieved using a lubricating oil which comprises less than 70% by mass of GTL base oil.

35 **[0007]** The inventors have found that improved air release is achieved when the base oil in the lubricating oil is predominantly GTL base oil.

50 Detailed Description of the Invention

[0008] The present invention provides a use for improving the air release of a lubricating oil in a hydraulic system. In a hydraulic system the lubricating oil is used not only to lubricate the machinery but also to transmit pressure. Air entrainment can be a particular issue in hydraulic systems, causing spongy or erratic operation of the hydraulics.

55 **[0009]** The air release is measured according to ASTM D3427 (Version 14a, 2015). Compressed air is blown through the lubricating oil, which has been heated to a temperature of 50 °C. After the air flow is stopped, the time required for the air entrained in the oil to reduce in volume to 0.2% is recorded as the air release time. A desirable air release value is typically less than 3 minutes, preferably less than 60 seconds and most preferably less than 20 seconds.

[0010] The air release is improved compared to air release achieved using a lubricating oil which comprises less than 70% by mass of GTL base oil. The comparison is between substantially equivalent lubricating oils wherein the only difference is in the amount of GTL base oil that is present. For example, the comparison should be between lubricating oils that are of the same viscosity and that contain the same additives. In the comparative lubricating oil there will be a greater quantity of non-GTL base oil. The non-GTL base oil is, for example, a base oil from Group I, II or III of the API base oil categories. By incorporating at least 70% by mass of GTL base oil the inventors have observed improved air release times as compared to lubricating oils having less than 70% by mass of GTL base oil (and wherein the GTL base oil has been replaced by a Group I, II or III base oil).

[0011] The lubricating oil is supplied to the hydraulic system using standard methods.

[0012] The lubricating oil comprises at least 90% by mass, based upon the mass of the lubricating oil, of base oil. At least 70% by mass, based upon the mass of the base oil, is GTL base oil. Preferably at least 75% by mass is GTL base oil. GTL base oils are synthesised by the Fischer-Tropsch method of converting natural gas to liquid fuel. They have very low sulphur content and aromatic content compared with mineral oil base oils refined from crude oil and have a very high paraffin constituent ratio. Up to 30% by mass (and preferably up to 25% by mass), based upon the mass of the base oil, may be another type of base oil, including conventional base oils chosen from Groups I, II, and III of the API (American Petroleum Institute base oil categories).

[0013] The base oil comprises at least 10% by mass of a base oil chosen from Group I, Group II or Group III.

[0014] The kinematic viscosity of the GTL base oil at 100°C is from 2 to 20cSt, preferably from 3 to 15cSt and more preferably from 3 to 10cSt. The viscosity is suitably measured using ASTM D445.

[0015] The lubricating oil comprises less than 10% by mass, based upon the mass of the lubricating oil, of additives. Preferably the amount of additives is less than 5% by mass. Preferably the amount of additives is at least 0.50 by mass. The additives may include antioxidants, antiwear additives, demulsifiers, emulsifiers, rust and corrosion inhibitors, VI improvers and/or friction modifiers. The additives may be supplied as additive packages, e.g. an ashless additive package or a zinc-based additive package.

[0016] The kinematic viscosity of the lubricating oil at 40°C is from 20 to 100cSt, preferably from 25 to 80cSt. The kinematic viscosity is suitably measured using ASTM D445 (ASTM D7042). This range of viscosities provides lubricating oils suitable for use in hydraulic systems.

[0017] The invention is further explained in detail below by means of examples, but the invention is in no way limited by these examples.

Example 1

[0018] Eleven different base oil blends were prepared using combinations of three base oils:

- 1) XHVI 8 (a Fischer-Tropsch derived oil available from Shell having a kinematic viscosity at 100°C of approximately 8cSt)
- 2) Yubase 8 (a Group III base oil from SK Lubricants having a kinematic viscosity at 100°C of approximately 8cSt)
- 3) Chevron 220 R (a Group II base oil from Chevron having a kinematic viscosity at 100°C of approximately 8cSt)

[0019] The air release time of the base oil blends was tested using the ASTM D3427 method at 50°C. Table 1 gives the amount of each base oil (in weight % based upon the total weight of the blend) present in each blend and the air release time at 50°C. The blends in Table 1 are all ISO 46.

Table 1

	XHVI 8	Yubase 8	Chevron 220 R	Air release time at 50°C (seconds)
Blend 1	100	0	0	5
Blend 2	75	25	0	5
Blend 3	66.7	33.3	0	30
Blend 4	50	50	0	40
Blend 5	25	75	0	60
Blend 6	0	100	0	77
Blend 7	0	0	100	61
Blend 8	50	0	50	46

(continued)

	XHVI 8	Yubase 8	Chevron 220 R	Air release time at 50°C (seconds)
Blend 9	90	0	10	5
Blend 10	80	0	20	5
Blend 11	75	0	25	15

[0020] The results show very fast air release for the blends having from 75 to 100wt% GTL (Reference Blend 1 and Inventive Blends 2, 9, 10 and 11). All the other blends, having less than 70% GTL, have significantly slower air release times.

Example 2 (not according to the invention)

[0021] Air release times are typically considered to get worse with the addition of additives. To demonstrate that fully formulated hydraulic oils according to the invention are resistant to changes in air release, blends were prepared using XHVI 8 (a Fischer-Tropsch derived oil available from Shell having a viscosity at 100°C of approximately 8cSt) and different amounts of either of the following:

1) Additive Package 1 (ashless additive package)

2) Additive Package 2 (zinc based additive package) Table 2 gives the blend compositions (in weight % based upon the total weight of the blend) for each of the additive packages with XHVI 8 and the corresponding air release times:

Table 2

	Additive Package 1	Additive Package 2	XHVI 8	Air Release Time at 50°C (seconds)
Blend 1	0	0	100	5
Blend 12	1	0	99	10
Blend 13	2.5	0	97.5	10
Blend 14	5	0	95	10
Blend 15	0	1	99	10
Blend 16	0	2	98	10
Blend 17	0	3	97	10
Blend 18	0	4	96	10
Blend 19	0	5	95	10
Blend 20	0	10	90	10

[0022] The results show that the addition of additive packages (either ashless or zinc based) does not significantly affect the air release properties of the lubricating oils.

Claims

1. The use, in a lubricating oil comprising at least 90% by mass, based upon the mass of the lubricating oil, of base oil wherein the base oil comprises at least 10% by mass of a base oil chosen from Group I, Group II or Group III, of at least 70% by mass, based upon the mass of the base oil, of GTL base oil to improve the air release of a lubricating oil in a hydraulic system, wherein the viscosity of the GTL base oil at 100°C is from 2 to 20cSt;

wherein the lubricating oil comprises less than 10% by mass, based upon the mass of the lubricating oil, of additives;

wherein the viscosity of the lubricating oil at 40°C is from 20 to 100cSt; and

wherein air release is measured according to ASTM D3427 and is improved as compared to air release achieved using a lubricating oil which comprises less than 70% by mass of GTL base oil.

2. Use according to claim 1, wherein the viscosity of the GTL base oil at 100°C is from 3 to 10cSt.
3. Use according to any preceding claim, wherein the lubricating oil comprises less than 5% by mass, based upon the mass of the lubricating oil, of additives.
4. Use according to any preceding claim, wherein the lubricating oil comprises at least 0.5% by mass, based upon the mass of the lubricating oil, of additives.
5. Use according to any preceding claim, wherein the viscosity of the lubricating oil at 40°C is from 25 to 80cSt.

Patentansprüche

1. Verwendung, in einem Schmieröl, umfassend mindestens 90 Masse-%, basierend auf der Masse des Schmieröls, Basisöl, wobei das Basisöl mindestens 10 Masse-% eines Basisöls umfasst, das aus der Gruppe I, Gruppe II oder Gruppe III ausgewählt ist, von mindestens 70 Masse-%, basierend auf der Masse des Basisöls, GTL-Basisöl, um die Luftfreisetzung eines Schmieröls in einem hydraulischen System zu verbessern, umfasst, wobei die Viskosität des GTL-Basisöls bei 100 °C von 2 bis 20 cSt beträgt;
wobei das Schmieröl weniger als 10 Masse-%, basierend auf der Masse des Schmieröls, Additive umfasst;
wobei die Viskosität des Schmieröls bei 40 °C von 20 bis 100 cSt beträgt; und
wobei die Luftfreisetzung gemäß ASTM D3427 gemessen wird und verglichen mit einer Luftfreisetzung verbessert wird, die unter Verwendung eines Schmieröls erreicht wird, das weniger als 70 Masse-% GTL-Basisöl umfasst.
2. Verwendung nach Anspruch 1, wobei die Viskosität des GTL-Basisöls bei 100 °C von 3 bis 10 cSt beträgt.
3. Verwendung nach einem der vorstehenden Ansprüche, wobei das Schmieröl weniger als 5 Masse-%, basierend auf der Masse des Schmieröls, Additive umfasst.
4. Verwendung nach einem der vorstehenden Ansprüche, wobei das Schmieröl mindestens 0,5 Masse-%, basierend auf der Masse des Schmieröls, Additive umfasst.
5. Verwendung nach einem der vorstehenden Ansprüche, wobei die Viskosität des Schmieröls bei 40 °C von 25 bis 80 cSt beträgt.

Revendications

1. Utilisation, dans une huile lubrifiante comprenant au moins 90 % en masse, sur la base de la masse de l'huile lubrifiante, d'huile de base, dans laquelle l'huile de base comprend au moins 10 % en masse d'une huile de base choisie dans le Groupe I, le Groupe II ou le Groupe III, d'au moins 70 % en masse, sur la base de la masse de l'huile de base, d'une huile de base GTL pour améliorer la libération d'air d'une huile lubrifiante dans un système hydraulique, dans laquelle la viscosité de l'huile de base GTL à 100 °C va de 2 à 20 cSt ;
dans laquelle l'huile lubrifiante comprend moins de 10 % en masse, sur la base de la masse de l'huile lubrifiante, d'additifs ;
dans laquelle la viscosité de l'huile lubrifiante à 40 °C va de 20 à 100 cSt ; et
dans laquelle la libération d'air est mesurée selon la norme ASTM D3427 et est améliorée par comparaison avec la libération d'air obtenue à l'aide d'une huile lubrifiante qui comprend moins de 70 % en masse d'huile de base GTL.
2. Utilisation selon la revendication 1, dans laquelle la viscosité de l'huile de base GTL à 100 °C va de 3 à 10 cSt.
3. Utilisation selon l'une quelconque revendication précédente, dans laquelle l'huile lubrifiante comprend moins de 5 % en masse, sur la base de la masse de l'huile lubrifiante, d'additifs.
4. Utilisation selon l'une quelconque revendication précédente, dans laquelle l'huile lubrifiante comprend au moins 0,5

EP 3 380 595 B1

% en masse, sur la base de la masse de l'huile lubrifiante, d'additifs.

5. Utilisation selon l'une quelconque revendication précédente, dans laquelle la viscosité de l'huile lubrifiante à 40 °C va de 25 à 80 cSt.

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REFERENCES CITED IN THE DESCRIPTION

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