

LUBRICATING COMPOSITION

The present invention relates to a lubricating composition, in particular to lubricating compositions for use in internal combustion engines operated under sustained high load conditions, such as marine diesel engines and power applications. More particularly, the present invention relates to a marine cylinder oil.

Marine cylinder oils are known in the art. As an example, WO 2008/043901 A2 discloses a cylinder lubricant for a two-stroke marine engine, having a Base Number (according to ASTM D 2986) of at least 40 mg KOH/g, and containing from 0.01 to 1.0 wt.% of a primary, secondary or tertiary mono-alcohol having at least 12 carbon atoms.

Lubricating compositions for use in internal combustion engines are subject to high levels of stress. It is important that the lubricating oil provides good lubrication properties under a variety of conditions, and amongst other properties, provides good wear, corrosion protection, help to keep the engine clean, be thermally and oxidatively stable and carry heat away from the engine.

Lubricating compositions used in marine diesel engines are subject to particularly high levels of stress due to the fact that marine engines are usually run continuously at near full load conditions for long periods of time.

It will be appreciated in the art that the term "marine" does not restrict such engines to those used in water-borne vessels. That is to say, in addition said term also includes engines used for power generation applications. These highly rated, fuel efficient, slow- and medium-speed marine and stationary diesel engines

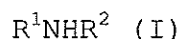
operate at high pressures, high temperatures and long-strokes.

It is an object of the present invention to improve the corrosive wear protection and BN retention properties of a lubricating composition, especially for use in an internal combustion engine such as a marine diesel engine.

It is another object of the present invention to provide alternative lubricating compositions for use in an internal combustion engine.

One or more of the above or other objects can be obtained by the present invention by providing a lubricating composition comprising:

- a base oil;
- a detergent; and
- an amine compound having the following general formula (I):



wherein R^1 represents a hydrocarbyl group containing 1 to 50 carbon atoms and R^2 is selected from the group consisting of a hydrogen atom (H) and a hydrocarbyl group containing 1 to 50 carbon atoms;

wherein the amine compound is present at a level of greater than 0.3wt%, by weight of the lubricating composition.

In this respect it is noted that WO 2008/095966 discloses an industrial oil composition, such as a hydraulic fluid, comprising a base oil, an aspartic acid derivative and an aliphatic amine compound. As indicated on page 12, line 9, the composition may include a detergent-dispersant. Apart from the fact that no actual examples containing a detergent are disclosed in WO 2008/095966, it is to be noted that industrial oil compositions (typically not containing a large amount of detergent) differ substantially from the engine oils

according to the present invention. As an example, the lubricating composition according to the present invention does preferably not contain an aspartic acid derivative.

5 It has now surprisingly been found according to the present invention that the lubricating compositions according to the present invention exhibit improved corrosive wear protection and/or BN retention and/or BN usage properties.

10 There are no particular limitations regarding the base oil used in lubricating composition according to the present invention, and various conventional mineral oils, synthetic oils as well as naturally derived esters such as vegetable oils may be conveniently used.

15 The base oil used in the present invention may conveniently comprise mixtures of one or more mineral oils and/or one or more synthetic oils; thus, according to the present invention, the term "base oil" may refer to a mixture containing more than one base oil. Mineral
20 oils include liquid petroleum oils and solvent-treated or acid-treated mineral lubricating oil of the paraffinic, naphthenic, or mixed paraffinic/naphthenic type which may be further refined by hydrofinishing processes and/or dewaxing.

25 Suitable base oils for use in the lubricating oil composition of the present invention are Group I-III mineral base oils, Group IV poly-alpha olefins (PAOs), Group I-III Fischer-Tropsch derived base oils and mixtures thereof.

30 By "Group I", "Group II", "Group III" and "Group IV" base oils in the present invention are meant lubricating oil base oils according to the definitions of American Petroleum Institute (API) for categories I-IV. These API categories are defined in API Publication 1509, 15th
35 Edition, Appendix E, April 2002.

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 of the present invention 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.

Synthetic oils include hydrocarbon oils such as olefin oligomers (including polyalphaolefin base oils; PAOs), dibasic acid esters, polyol esters, polyalkylene glycols (PAGs), alkyl naphthalenes and dewaxed waxy isomerates. Synthetic hydrocarbon base oils sold by the Shell Group under the designation "Shell XHVI" (trade mark) may be conveniently used.

Poly-alpha olefin base oils (PAOs) and their manufacture are well known in the art. Preferred poly-alpha olefin base oils that may be used in the lubricating compositions of the present invention may be derived from linear C₂ to C₃₂, preferably C₆ to C₁₆, alpha olefins. Particularly preferred feedstocks for said poly-alpha olefins are 1-octene, 1-decene, 1-dodecene and 1-tetradecene.

The total amount of base oil incorporated in the lubricating composition of the present invention is preferably present in an amount in the range of from 60 to 99 wt.%, more preferably in an amount in the range of from 65 to 98 wt.% and most preferably in an amount in the range of from 70 to 95 wt.%, with respect to the total weight of the lubricating composition.

There are no particular limitations regarding the detergent as used in lubricating composition according to the present invention and various conventional detergents or mixtures thereof may be conveniently used. Examples of detergents that may be used include oil-soluble neutral and over-based sulphonates, phenates, sulphurized phenates, thiophosphonates, salicylates and naphthenates and other oil-soluble carboxylates of a metal, particularly the alkali or alkaline earth metals, e.g. sodium, potassium, lithium, and in particular calcium and magnesium. Preferred metal detergents are neutral and over-based detergents having a TBN (Total Base Number; according to ASTM D2896) of from 20 to 450. Combinations of detergents, whether over-based or neutral or both, may be used.

The amount of the detergent in the compositions of the invention is typically from 0.01 wt.% to 35.0 wt.%, based on the total weight of the lubricating composition. According to a preferred embodiment of the present invention, the composition comprises at least 4 wt.% of the detergent, based on the total weight of the composition. Preferably the composition comprises at least 6 wt.%, more preferably 8 wt.%, even more preferably at least 10 wt.%, most preferably at least 15 wt.% of the detergent, based on the total weight of the composition.

Further it is preferred that the detergent is a selected from a sulphonate-type detergent, a phenate detergent, or a mixture thereof. Sulphonate-type and phenate-type detergents are well known in the art.

The amine compound having the general formula (I) as defined above may include a broad range of compounds. As mentioned above, R^1 represents a hydrocarbyl group containing 1 to 50 carbon atoms and R^2 represents H or a hydrocarbyl group containing 8 to 30 carbon atoms.

Although the hydrocarbyl groups of R^1 and R^2 may be saturated or unsaturated and linear or branched, they are preferably saturated carbon chains and preferably linear (thus unbranched). Preferably, R^1 and R^2 (if R^2 does not
5 represent H) both independently represent a hydrocarbyl group containing 4 to 40 carbon atoms and more preferably 8 to 30 carbon atoms, even more preferably 10 to 24 carbon atoms, most preferably 12 to 18 carbon atoms.

Preferably, R^2 in general formula (I) represents H.
10 In the latter case, the amine compound is a primary amine having the following general formula (II):
 R^1-NH_2 (II).

Further, it is preferred that, in general formula (I) or (II) above, R^1 represents a hydrocarbyl group
15 containing 8 to 30 carbon atoms, preferably 10 to 24 carbon atoms, more preferably 12 to 18 carbon atoms. Especially preferred primary amines are n-dodecylamine (laurylamine), n-tridecylamine, n-tetradecylamine (myristylamine), n-pentadecylamine, n-hexadecylamine (n-
20 palmitylamine), n-heptadecylamine and n-octadecylamine (n-stearylamine).

The amount of the amine compound in the composition of the invention is greater than 0.3 wt% and preferably less than 2.5 wt%, preferably in the range of from 0.4
25 wt% to 2.4 wt.%, more preferably in the range from 0.5 to 2.0 wt.%, and especially in the range of from 1.0 wt% to 2.0 wt%, based on the total weight of the lubricating composition.

The lubricating composition according to the present
30 invention may further comprise one or more other additives such as anti-oxidants, anti-wear additives, dispersants, other detergents, extreme pressure additives, other friction modifiers, viscosity modifiers, pour point depressants, metal passivators, corrosion inhibitors,
35 demulsifiers, anti-foam agents, seal compatibility agents

and additive diluent base oils, etc. However, preferably, the lubricating composition according to the present contains less than 5.0 wt.%, more preferably less than 4.0 wt.% or even less than 3.0 wt.% of any other additives than one or more detergents, one or more dispersants and one or more amine compound(s) having general formula (I). Preferably, the composition contains no other additives than one or more detergents, one or more dispersants and one or more amine compound(s) having general formula (I).

As the person skilled in the art is familiar with the above and other additives, these are not further discussed here in detail. Specific examples of such additives are described in for example Kirk-Othmer Encyclopedia of Chemical Technology, third edition, volume 14, pages 477-526.

The above-mentioned additives are typically present in an amount in the range of from 0.01 to 35.0 wt.%, based on the total weight of the lubricating composition, preferably in an amount in the range of from 5.0 to 30.0 wt.%, based on the total weight of the lubricating composition.

Preferably, the composition has a Total Base Number (TBN) value of at most 75 mg KOH/g, preferably at most 70 mg KOH/g, more preferably at most 65 mg KOH/g, even more preferably at most 60 mg KOH/g (in particular according to ASTM D 2896). Typically, the composition has a total base number (TBN) value (according to ASTM D 2896) of above 20.0 mg KOH/g.

Further it is preferred according to the present invention that the composition has a kinematic viscosity at 100°C of above 5.6 mm²/s and below 21.9 mm²/s, preferably above 12.5 mm²/s, more preferably above 14.3 mm²/s, in particular according to ASTM D 445.

The lubricating compositions of the present invention may be conveniently prepared by admixing the one or more additives with the base oil(s).

In another aspect, the present invention provides the use of a lubricating composition according to the present invention, in order to improve one or more of corrosive wear protection properties (in particular according to the below described procedure based on ASTM G181) and BN retention properties (in particular as measured according to ASTM D 2896). Further, the present invention provides the use of a lubricating composition according to the present invention, in order to improve BN retention properties, whilst maintaining corrosive wear protection properties.

The lubricating compositions according to the present invention are useful for lubricating apparatus generally, but in particular for use as engine oils for internal combustion engines. These engine oils include passenger car engines, diesel engines, marine diesel engines, gas engines, two- and four-cycle engines, etc., and in particular marine diesel engines.

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

Examples

Lubricating Oil Compositions

Various lubricating compositions for use as marine cylinder oils in a marine diesel engine were formulated.

Table 1 indicates the composition and properties of the formulations that were tested; the amounts of the components are given in wt.%, based on the total weight of the fully formulated formulations.

All tested marine diesel engine oil formulations were formulated as SAE 40 or SAE 50 formulations meeting

the so-called SAE J300 Specifications (as revised in January 2009; SAE stands for Society of Automotive Engineers).

5 All the tested marine cylinder oil formulations contained a combination of a base oil, a detergent additive package and - if present - a fatty amine or a fatty alcohol. The detergent additive packages contained a combination of neutral and over-based detergents.

10 "Base oil 1" was a commercially available Group I base oil blend having a kinematic viscosity at 100°C (ASTM D445) of approx. 16 cSt (mm^2s^{-1}). This base oil blend is commercially available from e.g. Shell Chemicals Ltd. (London, UK) under the trade designation "Catenex".

15 "Base oil 2" was a base oil blend containing a thickener and 75 wt.% of a Group II base oil; the blend is commercially available from Chevron Products Company (San Ramon, CA, USA) under the trade designation "Chevron 600 R".

20 "Detergent package 1" was a salicylate-type detergent package. Detergent package 1 is commercially available from e.g. Infineum UK Ltd, (Abingdon, UK) under the trade designation "Infineum M".

25 "Detergent package 2", "Detergent package 3" and "Detergent package 4" were blends of phenate-type and sulphonate-type detergents. Detergent packages 2, 3 and 4 components are commercially available from e.g. Chevron Oronite (Windsor, UK) under the trade designations "OLOA 219C" , "OLOA 249SX" and "OLOA 246S" respectively. "Amine 1" was a n-hexadecylamine. Amine 1 is commercially
30 available from e.g. Sigma-Aldrich (St. Louis, USA) under the trade designation "445312 (Aldrich)".

"Amine 2" was a n-docecylamine. Amine 2 is commercially available from e.g. Sigma-Aldrich (St. Louis, USA) under the trade designation "D3629 (Sigma)".

35 "Alcohol 1" was a n-octadecanol. Alcohol 1 is

commercially available from e.g. Merck KGaA (Darmstadt, Germany) under the trade designation "807680 Stearyl alcohol".

5 "Alcohol 2" was a n-hexadecanol. Alcohol 2 is commercially available from e.g. Merck KGaA (Darmstadt, Germany) under the trade designation "818704 Cetyl alcohol".

10 The compositions of Examples 1-10 and Comparative Examples 1-10 were obtained by mixing the base oils with the detergent, amine and/or alcohol using conventional lubricant blending procedures.

Table 1

Component [wt.%]	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Ex. 7	Ex. 8
Base oil 1 (Group I)	71.0	71.0	72.6	72.6	69.5	69.5	77.9	77.9
Base oil 2 (Group II)	-	-	-	-	-	-	-	-
Detergent package 1 (salicylate)	28.0	28.0	-	-	-	-	-	-
Detergent package 2 (phenate + sulphonate)	-	-	26.4	26.4	24.5	25.0	10.2	10.7
Detergent package 3 (phenate + sulphonate)	-	-	-	-	5.0	5.0	10.9	10.9
Detergent package 4 (phenate + sulphonate)	-	-	-	-	-	-	-	-
Amine 1 (n-hexadecylamine)	1.0	-	1.0	-	1.0	0.5	1.0	0.5
Amine 2 (n-dodecylamine)	-	1.0	-	1.0	-	-	-	-
Alcohol 1 (n-octadecanol)	-	-	-	-	-	-	-	-
Alcohol 2	-	-	-	-	-	-	-	-

(n-hexadecanol)								
TOTAL	100	100	100	100	100	100	100	100
Properties of the formulated lubricating composition								
TBN value ¹ [mg KOH/g]	71.28	71.96	72.69	73.55	57.64	56.70	42.64	42.11
Kinematic viscosity at 100°C ² [cSt]	19.78	19.62	18.75	18.56	19.40	19.42	19.24	19.27
Kinematic viscosity at 40°C ² [cSt]	200.5	199.4	209.1	207.1	230.1	229.5	228.5	227.6

¹According to ASTM D 2896; ²According to ASTM D 445

Table 1 (continued)

Component [wt.%]	Comp. Ex. 1	Comp. Ex. 2	Comp. Ex. 3	Comp. Ex. 4	Comp. Ex. 5	Comp. Ex. 6	Comp. Ex. 7
Base oil 1 (Group I)	71.0	72.6	69.5	77.9	71.0	71.0	72.6
Base oil 2 (Group II)	-	-	-	-	-	-	-
Detergent package 1 (salicylate)	29.0	-	-	-	28.0	28.0	-
Detergent package 2 (phenate + sulphonate)	-	27.4	25.5	11.2	-	-	26.4
Detergent package 3 (phenate + sulphonate)	-	-	5.0	10.9	-	-	-
Detergent package 4 (phenate + sulphonate)	-	-	-	-	-	-	-
Amine 1 (n-hexadecylamine)	-	-	-	-	-	-	-
Amine 2 (n-dodecylamine)	-	-	-	-	-	-	-
Alcohol 1 (n-octadecanol)	-	-	-	-	1.0	-	1.0

Alcohol 2 (n-hexadecanol)	-	-	-	-	-	1.0	-
TOTAL	100	100	100	100	100	100	100
Properties of the formulated lubricating composition							
TBN value ¹ [mg KOH/g]	73.01	70.67	55.56	41.41	69.35	69.19	71.11
Kinematic viscosity at 100°C ² [cSt]	19.62	19.43	19.42	19.28	19.14	19.61	18.84
Kinematic viscosity at 40°C ² [cSt]	197.9	220.4	228.2	225.7	193.1	191.9	209.3

¹According to ASTM D 2896; ²According to ASTM D 445

Table 1 continued

Component [wt.%]	Comp. Ex. 8	Comp. Ex. 9	Comp. Ex. 10	Ex. 9	Ex. 10
Base oil 1 (Group I)	-	-	-	-	-
Base oil 2 (Group II)	78.0	78.0	78.0	78.0	78.0
Detergent package 1 (salicylates)	-	-	-	-	-
Detergent package 2 (phenate + sulphonate)	-	-	-	-	-
Detergent package 3 (phenate + sulphonate)	-	-	-	-	-
Detergent package 4 (phenate + sulphonate)	22.0	22.0	22.0	22.0	22.0
Amine 1 (n-hexadecylamine)	-	0.2	0.3	0.5	1.0
Amine 2 (n-dodecylamine)	-	-	-	-	-
Alcohol 1 (n-octadecanol)	-	-	-	-	-

Alcohol 2 (n-hexadecanol)	-	-	-	-	-
TOTAL	100	100	100	100	100
Properties of the formulated lubricating composition					
TBN value ¹ [mg KOH/g]	58.4	58.83	59.15	59.56	60.67
Kinematic viscosity at 100°C ² [cSt]	15.36	15.28	15.24	15.15	14.85
Kinematic viscosity at 40°C ² [cSt]	142.5	141.1	140.4	138.8	136.5

¹According to ASTM D 2896; ²According to ASTM D 445

Corrosive Wear Test

In order to demonstrate the corrosive wear protection properties of the present invention, measurements were performed with a corrosive procedure based on the standard ASTM G181 test ("Standard practice for conducting friction tests of piston ring and cylinder liner materials under lubricated conditions") for determining corrosive wear whilst using the well-known Plint TE-77 Reciprocating Test Rig (available from Phoenix Tribology Ltd, Newbury, UK) in which a moving specimen is reciprocated against a stationary plate to simulate piston top position under closely controlled conditions. As test specimen a steel plate (Steel 20 RC, annealed) and a pin finely machined from a 2-stroke engine piston ring (Bolnes DNL 190/600) were used.

During the test a lubricating oil feed rate of 0.05 ml/min was used; also an acid (acid strength: H_2SO_4 6N) feed rate of 0.05 ml/min over the contact surface on the plate was used, during 5 minutes each 10 minutes (i.e. 5 minutes off, 5 minutes on, 5 minutes off, etc.). In the test, the following test conditions were used:

- Load: 200 N
- Temperature: 180°C
- Reciprocating Frequency: 10 Hz
- Stroke length: 15 mm
- Time: 60 minutes.

The measured corrosive wear properties are indicated in Table 2 below.

Table 2

	Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ex. 5	Ex. 6	Ex. 7	Ex. 8
TBN value ¹ [mg KOH/g]	58.08	60.05	66.16	67.16	50.04	48.15	34.29	31.41
Consumed BN ² [%]	18.51	16.55	8.98	8.69	13.18	15.08	19.58	25.41
Total corrosive wear ³ [µm]	221	192	117	146	118	191	155	210
Normalised corrosive wear ⁴	0.73	0.64	0.47	0.59	0.36	0.58	0.30	0.40

¹According to ASTM D 2896, after test; ²Decrease of BN compared with TBN value before test (see Table 1); for Example 1 this is $[(71.28-58.08)/71.28]*100\% = 18.52$; ³Total corrosive wear is the sum of wear scar depth on plate and pin height reduction. Wear scar depth on plate was measured with a depth gauge (Digimatic Indicator ID-H, available from Mitutoyo Corporation) and pin height reduction was measured with a micrometer (Absolute Digimatic Micrometer, available from Mitutoyo Corporation); ⁴The normalised corrosive wear is the measured total wear [µm] divided by the measured wear for the selected Comparative Example (based on the same detergent formulation). Examples 1 and 2 and Comparative Examples 5 and 6 are compared to Comparative Example 1 (and therefore the normalised wear for Comp. Ex. 1 is 1.00); Examples 3 and 4 and Comp. Ex. 7 are compared to Comp. Ex. 2.; Examples 5 and 6 are compared to Comp. Ex. 3; and Examples 7 and 8 are compared to Comp. Ex. 4. Examples 9 and 10 are compared to Comparative Examples 8, 9 and 10.

Table 2 (continued)

	Comp. Ex. 1	Comp. Ex. 2	Comp. Ex. 3	Comp. Ex. 4	Comp. Ex. 5	Comp. Ex. 6	Comp. Ex. 7
TBN value ¹ [mg KOH/g]	53.50	55.01	44.68	35.92	53.36	52.43	55.59
Consumed BN ² [%]	26.72	22.15	19.58	13.25	23.05	24.22	21.82
Total corrosive wear ³ [µm]	302	249	329	523	286	366	273
Normalised corrosive wear ⁴	1.00	1.00	1.00	1.00	0.95	1.21	1.10

¹According to ASTM D 2896, after test; ²Decrease of BN compared with TBN value before test (see Table 1); for Example 1 this is $[(71.28-58.08)/71.28]*100\% = 18.52$; ³Total corrosive wear is the sum of wear scar depth on plate and pin height reduction. Wear scar depth on plate was measured with a depth gauge (Digimatic Indicator ID-H, available from Mitutoyo Corporation) and pin height reduction was measured with a micrometer (Absolute Digimatic Micrometer, available from Mitutoyo Corporation); ⁴The normalised corrosive wear is the measured total wear [µm] divided by the measured wear for the selected Comparative Example (based on the same detergent formulation). Examples 1 and 2 and Comparative Examples 5 and 6 are compared to Comparative Example 1 (and therefore the normalised wear for Comp. Ex. 1 is 1.00); Examples 3 and 4 and Comp. Ex. 7 are compared to Comp. Ex. 2.; Examples 5 and 6 are compared to Comp. Ex. 3; and Examples 7 and 8 are compared to Comp. Ex. 4. Examples 9 and 10 are compared to Comparative Examples 8, 9 and 10.

Table 2 continued

	Comp. Ex. 8	Comp. Ex. 9	Comp. Ex. 10	Ex. 9	Ex. 10
TBN value ¹ [mg KOH/g]	41.97	44.80	45.29	44.26	45,59
Consumed BN ² [%]	28,13	23,85	23,43	25,69	24,86
Total corrosive wear ³ [µm]	246	232	239	195	180
Normalised corrosive wear ⁴	1.0	0.94	0.97	0.79	0.73

¹According to ASTM D 2896, after test; ²Decrease of BN compared with TBN value before test (see Table 1); for Example 1 this is $[(71.28-58.08)/71.28]*100\% = 18.52$; ³Total corrosive wear is the sum of wear scar depth on plate and pin height reduction. Wear scar depth on plate was measured with a depth gauge (Digimatic Indicator ID-H, available from Mitutoyo Corporation) and pin height reduction was measured with a micrometer (Absolute Digimatic Micrometer, available from Mitutoyo Corporation); ⁴The normalised corrosive wear is the measured total wear [µm] divided by the measured wear for the selected Comparative Example (based on the same detergent formulation). Examples 1 and 2 and Comparative Examples 5 and 6 are compared to Comparative Example 1 (and therefore the normalised wear for Comp. Ex. 1 is 1.00); Examples 3 and 4 and Comp. Ex. 7 are compared to Comp. Ex. 2.; Examples 5 and 6 are compared to Comp. Ex. 3; and Examples 7 and 8 are compared to Comp. Ex. 4. Examples 9 and 10 are compared to Comparative Examples 8, 9 and 10.

Discussion

As can be learned from Table 2, the corrosive wear protection and BN retention properties for the compositions according to the present invention were significantly improved when compared with Comparative Examples 1-4 and 8, which contain a base oil and one or more detergents but no amine compound; more specifically, the presence of the amine compound in the Examples according to the present invention resulted in a lower consumed BN (and thus better BN retention), optimal use of the consumed fraction of BN (i.e. improved BN usage) and lower Total and Normalised corrosive wear. In this respect it is noted that although Comparative Examples 3 and 4 showed desirable consumed BN values, they exhibited much worse corrosive wear data (see e.g. Total corrosive wear).

Also, it can be seen that the corrosive wear protection properties for the compositions according to the present invention were significantly improved when compared with Comparative Examples 5-7, which contain a base oil, one or more detergents and a primary fatty alcohol. In this respect it is noted that such primary fatty alcohols have been recently suggested (see WO 2008/043901) for the purpose of BN usage optimisation, meaning improved acid neutralisation properties and thus improved corrosive wear protection.

From the comparison of the BN retention values of Examples 1 to 3 it can be learned that according to the present invention there is a preference for a mixture of a sulphonate-type and a phenate-type detergent (rather than a salicylate-type detergent); this, as Examples 3 and 4 exhibit a lower consumed BN and thus a better BN retention for the given 70 BN level.

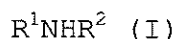
Furthermore, it can be learned from Examples 5 to 8 that TBN levels of 40 (Examples 7 and 8) and 55 (Examples

5 and 6) in combination with amines resulted in a total wear value that is comparable with or less than (i.e. improved) those of Comparative Examples 1 and 2. This surprisingly suggests that a composition having a relatively low TBN (e.g. 40 or 55) but containing amines will perform equal or better in corrosive wear protection when compared to a composition having a relatively high TBN (e.g. 70) without amines, providing a route to formulate lower BN products as alternative for existing commercial 70 BN marine cylinder lubricants.

Furthermore, it can be learned from Comparative Examples 8-10 and Examples 9 and 10 that a level of greater than 0.3 wt% of amine compound provides significantly lower corrosive wear. Comparative Examples 9 and 10 (containing only 0.2 wt% and 0.3 wt% amine, respectively) had a total corrosive wear of 232 μm and 239 μm , respectively, while Examples 9 and 10 (containing 0.5 wt% and 1.0 wt% of amine, respectively) had a total corrosive wear of 195 μm and 180 μm , respectively.

C L A I M S

1. A lubricating composition comprising:
 - a base oil;
 - a detergent; and
 - an amine compound having the following general formula (I):



wherein R^1 represents a hydrocarbyl group containing 1 to 50 carbon atoms and R^2 is selected from the group consisting of H and a hydrocarbyl group containing 1 to 50 carbon atoms;

wherein the amine compound is present at a level of greater than 0.3 wt%, by weight of the lubricating composition,

wherein the detergent is selected from neutral and over-based metal detergents having a Total Base Number according to ASTM D 2896 of from

20 to 450, wherein the composition comprises at least 8 wt% of the detergent, based on the total weight of the composition, and wherein the composition has a Total Base Number (TBN) value according to ASTM D 2896 of above 20.0 mg KOH/g.

2. Lubricating composition according to Claim 1 wherein the amine compound is present at a level of less than 2.5 wt%, by weight of the lubricating composition.

3. Lubricating composition according to Claim 1 or 2 wherein the amine compound is present at a level in the range of from 0.4 wt% to 2.4 wt%, by weight of the lubricating composition.

4. Lubricating composition according to any of Claims 1 to 3 wherein the amine compound is present at a level in

the range of from 0.5 wt% to 2.0 wt%, by weight of the lubricating composition.

5. Lubricating composition according to any of claims 1 to 4, wherein R^2 represents H.

6. Lubricating composition according to any of claims 1 to 5, wherein R^1 represents a hydrocarbyl group containing 8 to 30 carbon atoms.

7. Lubricating composition according to any of claims 1 to 6, wherein the composition comprises at least 10 wt.% of the detergent, based on the total weight of the composition.

8. Lubricating composition according to any of claims 1 to 7, wherein the detergent is selected from a sulphonate-type detergent, a phenate-type detergent, or a mixture thereof.

9. Lubricating composition according to any of claims 1 to 8, wherein the composition has a Total Base Number (TBN) value of at most 75 mg KOH/g according to ASTM D 2896.

10. Lubricating composition according to any of claims 1 to 9, wherein the composition has a Total Base Number (TBN) value of at most 65 mg KOH/g according to ASTM D 2896.

11. Lubricating composition according to any of claims 1 to 10, wherein the composition has a kinematic viscosity at 100°C of above 5.6 mm²/s and below 21.9 mm²/s.

12. Lubricating composition according to any of claims 1 to 11, wherein the composition contains no other additives than one or more detergents, one or more dispersants and one or more amine compound(s) having general formula (I).

13. Use of a lubricating composition according to any of claims 1 to 12, in order to improve one or more of corrosive wear protection properties according to ASTM

- 25 -

G181, BN retention and BN usage properties as measured according to ASTM D 2896.