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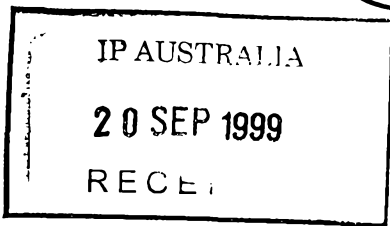
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(21) International Application Number: PCT/US99/04151 (22) International Filing Date: 25 February 1999 (25.02.99) (30) Priority Data: 09/041,494 12 March 1998 (12.03.98) US <i>CROMPTON CORPORATION</i> (71) Applicant: WIPAC CORPORATION [US/US]; One American Lane, Greenwich, CT 06831 (US). (72) Inventors: MUIR, Ronald, J.; 4 Invergarg Drive, West Hill, Ontario M1C 3M4 (CA). MATHEWS, Leonard; 3300 Wall Boulevard, Gretna, LA 70056 (US). ELIADES, Theo, I.; 1452 Military Trail, Scarborough, Ontario M1C 1A9 (CA). (74) Agent: WELCH, Edward, K., II; One American Lane, Greenwich, CT 06831 (US).		(81) Designated States: AU, BR, CA, JP, KR, MX, SG, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i>  

(54) Title: MARINE CYLINDER OILS CONTAINING HIGH VISCOSITY DETERGENTS**(57) Abstract**

Marine cylinder oils require a relatively high viscosity, and therefore generally include substantial amounts of an albeit costly high viscosity lubricating oil of at least about 2000 to 4000 SUS at 100 °F. The use of overbased detergents with viscosities of at least about 180 cST at 100 °C, such as high viscosity overbased calcium sulfonates and phenates, was found to reduce the need for substantial amounts of the high viscosity lubricating oil and still achieve the desired finished marine cylinder oil viscosity. The weight percent of the high viscosity oil in the marine cylinder oil is inversely commensurately proportional to the viscosities of the detergent and lubricating oil for a predetermined marine cylinder oil viscosity. The present invention provides a marine cylinder oil with a viscosity of at least about 15 to 25 cST at 100 °C, with reductions of more than about 12 % to 16 % or more by weight of the costly high viscosity or bright stock oil by the use of high viscosity detergents.

5 **MARINE CYLINDER OILS CONTAINING HIGH VISCOSITY DETERGENTS****BACKGROUND OF THE INVENTION**Field of the Invention

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This invention relates to marine cylinder oils containing overbased detergents for the lubrication between piston rings and cylinder walls in high output adverse environment engines.

Background and Discussion of the Prior Art

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Particularly high rates of wear occur in high output marine engines or oceangoing vessel diesel engines, and particularly when these adverse environment engines are operated on fuels containing significant amounts of sulfur and asphaltenes. The oils subject to these adverse cylinder and piston ring environments are known as marine cylinder oils or cylinder oils. It was
20 therefore necessary for marine cylinder oils to meet diverse stringent requirements. Marine cylinder oils are, generally speaking, blends of a high viscosity base oil and a solvent neutral or paraffinic oil, with detergents such as an overbased calcium sulfonate and overbased calcium phenate.

25

Marine cylinder oils are consumed with each stroke at a typical rate of about 0.9 g/hphr (1.20 g/kwhr) while being subjected to a severe environment. The marine cylinder oils, unlike conventional lubricating oils, must perform extremely broad functions, including the ability to spread over the entire cylinder liner surface, the ability to resist the effects of temperature, pressure, oxygen, moisture, and combustion products, the ability to maintain an oil film between
30 piston rings, piston and cylinder liners, and also the ability to prevent corrosive wear and resist oxidation under extreme conditions.

35

In addition to the foregoing stringent demands, the marine cylinder oil art greatly desired a low cost product particularly so because of the high level of consumption.

Reported test data suggests that cylinder liner wear and piston ring wear would decrease with increase in the marine cylinder oil viscosity. The art was for the foregoing reasons directed

5 to additive packages for improving viscosity as well as other characteristics. Additives, however, are costly components.

Another prior art solution to achieve the requisite viscosity was to provide substantial amounts of a high viscosity lubricating base oil having a viscosity of at least about 2000 to 4000
10 SUS at 100°F, in combination with the low cost, low viscosity, refined solvent neutral paraffinic oil which has a viscosity of only about 500 SUS at 100°F. The high viscosity base oil, such as a bright stock oil, however, was more costly and less stable at high temperatures than the solvent neutral oil.

15 The art directed to lubricating oils required overbased detergents with improved filterability and reduced viscosity, and was therefore directed away from the use of high viscosity detergents. This prior art direction is discussed in U.S. 5,011,618, granted April 30, 1991 to Papke et al and U.S. 4,387,033, granted June 7, 1983 to Lenack et al.

20 The present invention provides improved marine cylinder oil viscosity with a reduction in the amount of the high viscosity base oil thereby achieving cost effectiveness.

SUMMARY OF THE INVENTION

25 Broadly speaking the present invention is the use of high viscosity detergents in a marine cylinder oil. The invention, in a first broad aspect, is a marine cylinder oil which comprises a high viscosity lubricating base oil and a high viscosity detergent wherein the weight percent of the lubricating oil is inversely commensurately proportional to the viscosities of the lubricating oil and detergent for a predetermined marine oil viscosity. The invention, in a second broad aspect,
30 comprises a marine cylinder oil blend of a first oil having a first viscosity and a second oil having a second viscosity, with the first oil viscosity being substantially higher than the second oil viscosity, and an overbased detergent with an inherent high viscosity, wherein the weight percentage of the first oil in the marine oil is inversely commensurately proportional to the viscosity of the overbased detergent for a predetermined marine oil viscosity. The term
35 "substantially higher" as used hereinbefore and hereinafter in the context of lubricating oil viscosity means that the first oil viscosity is at least about 800 SUS at 100°F or more than the second oil viscosity. The viscosity of the high viscosity component lubricating oil is at least about

5 2000 SUS at 100°F. The marine cylinder oil may also comprise in addition to the first detergent, a second detergent of a still higher viscosity. The first detergent may preferably be an overbased calcium sulfonate with a viscosity of at least about 180 cST at 100°C and the second detergent may preferably be an overbased calcium phenate with a viscosity of at least about 200 cST and preferably at least about 250 cST at 100°C. The final marine oil blend preferably has a viscosity
10 of at least about 15 to 25 cST or more at 100°C.

A cost effective way to achieve the desired finished marine cylinder oil viscosity is to blend relatively substantial amounts of an inexpensive low viscosity oil with an expensive high viscosity oil, such as a bright stock oil. In this manner, marine cylinder oil compositions of this
15 invention may comprise no more than about 35% by weight of a bright stock oil. The finished marine cylinder oil may preferably contain a combination of a high viscosity overbased calcium sulfonate and a high viscosity overbased calcium phenate, or if desired 100% of the overbased calcium sulfonate. Insofar as the high viscosity overbased phenate is generally more costly than the high viscosity overbased sulfonate, a blend of the phenate and sulfonate provides optimization
20 of both viscosity and economy.

DESCRIPTION OF THE INVENTION

The Marine Cylinder Oil

25

The marine cylinder oil of the present invention, in one embodiment, is a high viscosity lubricating base oil with a viscosity of at least about 2000 SUS at 100°F and an inherent high viscosity overbased detergent with a viscosity of at least about 180 cST at 100°C, wherein the weight percent of the lubricating oil in the marine cylinder oil is inversely commensurately
30 proportional to the viscosities of the detergent and lubricating oil for a predetermined marine cylinder oil viscosity.

The marine cylinder oil of the present invention, in another embodiment, is a blend of a solvent neutral paraffinic or like oil having a relatively low viscosity of no more than about 500
35 SUS at 100°F, a bright stock or like oil having a relatively high viscosity of at least about 2000 SUS at 100°F, and an inherent high viscosity overbased detergent such as calcium phenate or calcium sulfonate, and preferably a combination of the calcium sulfonate and calcium phenate.

5 The calcium sulfonate preferably has a viscosity of from at least about 180 to 500 cST at 100°C, and up to 800 cST at 100°C, and the calcium phenate preferably has a viscosity of from at least about 200 to 800 cST or more at 100°C, and most preferably at least about 250 to 600 cST or more at 100°C. The marine cylinder oil blend comprises no more than about 35% by weight, and preferably no more than about 30% by weight, of the high viscosity oil, and yet achieves a desired
10 marine cylinder oil blend viscosity of at least about 15 to 25 cST or more at 100°C. The weight percentage of the bright stock oil in the marine cylinder oil blend is inversely commensurately proportional to the viscosities of the overbased calcium sulfonate and calcium phenate. The marine cylinder oil blend has a TBN of at least about 10 and preferably at least about 50 to 90 or more. The overbased calcium sulfonate and overbased calcium phenate are blended to provide
15 the desired TBN.

The overbased detergent is present in the marine cylinder oil in amounts of about 2 to 23% by weight and preferably about 10 to 20% by weight. Where a combination of detergents is used, the total detergent present in the marine cylinder oil is preferably in an amount of about 10
20 to 25% by weight.

The relatively low cost, low viscosity (i.e., 500 SUS at 100°F or less) solvent neutral oil may be present in the marine cylinder oil in amounts greater than about 40% by weight, and preferably 80% by weight or more, where the inherent high viscosity overbased detergent is
25 present. The low viscosity solvent neutral oil preferably has a viscosity of no more than about 900 SUS at 100°F.

It has been found that the marine cylinder oil of the present invention achieves a comparable viscosity to that of prior art blends but reduces the high viscosity lubricating oil (e.g.
30 bright stock oil) component requirement by at least 10% by weight, and generally from 12 to 16% by weight or more. This commensurately substantially reduces the cost of the finished marine cylinder oil.

In the finished marine cylinder oil, other additives may be included such as dispersants,
35 pour depressors, antioxidants, oleaginous agents, antifoamants and mixtures thereof. A preferred dispersant is an alkyl succinimide, which is added in amounts of from about 1 to 2%. A still

- 5 further specific additive which may be included is a polymeric dimethyl silicone antifoamant. The silicone polymer antifoamant is desirably employed in amounts of about 100 to 1000 ppm.

The marine cylinder oil of the present invention may preferably be substantially free of costly viscosity index improvers.

10

The High Viscosity Overbased Calcium Sulfonate

- 15 The overbased calcium sulfonate is formed from a mixture of a sulfonic acid, a hydrocarbon solvent, an alcohol, water and adding a stoichiometric excess of a calcium hydroxide above that required to react with the sulfonic acid, and carbonating the mixture with a carbon dioxide source at a specific temperature range of 80° to 150°F, which after filtration and stripping produces a 400 TBN calcium sulfonate having an inherent high viscosity of from about 180 to 500 cST or higher at 100°C.

- 20 The process for preparing an inherent high viscosity overbased calcium sulfonate includes the steps of: providing a sulfonic acid to a reactor, adding calcium hydroxide or calcium oxide to the reactor for neutralization and overbasing, adding a lower aliphatic C₁ to C₄ alcohol and a hydrocarbon solvent, to form a process mixture in a reactor which is at a temperature in the range of up to about 80°F, injecting carbon dioxide into the reactor until substantially all of the lime has
25 been carbonated while maintaining the exotherm of the reaction to between 80° and 150°F, and preferably 110° to 125°F, adding a quantity of oil to the reacted mixture to form a product mixture, clarifying the product mixture by filtering solids and distilling off the volatile hydrocarbon solvents and water, so that a bright, clear highly overbased inherent high viscosity calcium sulfonate is formed.

30

- The sulfonic acid may be a natural or synthetic sulfonic acid and may include a calcium salt of the sulfonic acid. In one important aspect, the present invention provides that at least 50% and preferably 80% or more by weight of the sulfonic acid be a natural sulfonic acid. The sulfonic acids are prepared by treating petroleum products with sulfuric acid or SO₃. The
35 compounds in the petroleum product which become sulfonated contain an oil solubilizing group. The acids thus obtained are known as petroleum sulfonates. Included within the meaning of sulfonates are the salts of sulfonic acids such as those of alkylaryl compounds. These acids are

5 prepared by treating an alkylaryl compound with sulfuric acid or SO_3 . At least one alkyl
substituent of the aryl compound is an oil solubilizing group as discussed above. The acids thus
obtained are known as alkylaryl sulfonic acids and the salts as alkylaryl sulfonates. The sulfonates
wherein the alkyl is a straight-chain alkyl are the well known linear alkyl sulfonates (LAS). The
acids are then converted to the metal salts thereof by neutralization with a calcium compound,
10 particularly including calcium hydroxide.

The sulfonates in addition to having a high viscosity are highly overbased. Overbased
materials are characterized by a metal content in excess of that which would be present according
to the stoichiometry of the calcium and the particular organic compound said to be overbased.
15 Thus an oil soluble monosulfonic acid when neutralized with a calcium compound, will produce a
normal sulfonate containing one equivalent of calcium for each equivalent of acid. In other words
the normal sulfonate will contain one mol of calcium for each two mols of the monosulfonic acid.
By applying well-known procedures "overbased" or "basic" complexes of the sulfonic acids can
be obtained. These overbased materials can contain amounts of metal many times in excess of
20 that required to neutralize the acid. These stoichiometric excesses can vary considerably, e.g.,
from about 0.1 to about 30 or more equivalents depending upon the reactants and the process
conditions. The highly overbased calcium sulfonates have TBN (ASTM D 2896) values ranging
from about 200 to about 500, and preferably in excess of 400.

25 The lime reactant may encompass hydrated lime in the form of calcium hydroxide.

Typically, the lower aliphatic alcohol reactant may be an alcohol selected from the group
consisting of alkanol of from 1 to 4 carbons, and in a preferred embodiment the lower aliphatic
alcohol is methanol. The quantity of C_1 to C_4 alkanol or lower aliphatic alcohol added to the
30 reaction mixture is in amounts such that the amount to the total promoter is less than about 15%
by weight of the yield of finished product formed in the last step of the process. The C_1 to C_4
alkanol is present in the range of about 8% to 10%, and usually about less than 12%, of the
finished product.

35 The petroleum hydrocarbon solvent particularly includes a paraffinic solvent having a
boiling amount range of 160° to 330°F .

5 The High Viscosity Overbased Calcium Phenate

In addition to high viscosity overbased calcium sulfonate, a high viscosity overbased calcium phenate may preferably also be present, alone or in combination with the sulfonate, in the marine cylinder oil. The overbased calcium phenate has a viscosity of at least about 180 cST and
10 100°C, and preferably 200 to 800 cST at 100°C, and most preferably 250 to 600 cST at 100°C. Methods for producing useful overbased calcium phenates are disclosed in U.S. Patent No. 5,281,345, granted January 25, 1994, to Crawford et al., EPO 0 354 647, published February 14, 1990, and U.S. Patent No. 4,104,180, granted August 1, 1978 to Burnop ("Burnop"). While high viscosity overbased detergents are known in the art, they are often avoided. Burnop, by way
15 of example, includes a discussion directed to avoiding the production of such high viscosity phenates.

While the invention is principally described for high viscosity sulfonates and phenates, high viscosity carboxylates are also within the contemplation of the invention. The sulfonates,
20 phenates and carboxylates are present in the marine oil in the form of their Group I and Group II metal salts. Group I metals useful in forming the detergent include lithium, sodium and potassium. Group II metals useful in forming the detergent agent include magnesium, calcium and barium, of which calcium is most preferred.

25 The present invention is further illustrated by the following examples, which are not, however, to be construed as limitations. All references to "parts" or "percentages" are references to parts or percentages by weight unless otherwise expressly indicated.

EXAMPLES 1-4

30

Overbased Calcium Sulfonate

A sulfonic acid is prepared from 50 to 95 weight percent of a sulfonic acid made by sulfonating a 310 to 700 SUS at 100°F petroleum oil and a 5 to 50 weight percent sulfonic acid
35 made of synthetic alkyl benzenes carbonated in the presence of calcium hydroxide, an alkylate solvent and methanol.

5 Table 1, below, shows the results of carbonating a 95/5 parts by weight mixture of the above mentioned natural and synthetic sulfonic acids with an initial reactor temperature of 135°F and controlling the exotherm to maintain the reaction below about 145°F.

Table 1

10	<u>Charge</u>	<u>wt%</u>
	Mixed sulfonic acid	18.7
	Oil	45.5
15	Crude heptane	65.2
	Methanol	10.0
	Lime	45.0
	Carbon dioxide	16.0
	Carbonation temperature	135-148°F
20	Carbonation time	90 minutes.

Results after filtration and stripping

	TBN	393
25	Calcium sulfonate, wt%	18.5
	Kinetic viscosity at 100° C, cST	75.

30 Table 2, below, shows the results of carbonating a 95/5 parts by weight mixture of the above mentioned natural and synthetic sulfonic acid with an initial reactor temperature of 130°F and controlling the exotherm to maintain the reaction below 135°F.

Table 2

35	<u>Charge</u>	<u>wt%</u>
	Mixed sulfonic acid	18.7
	Oil	45.5

5	Crude heptane	65.2
	Methanol	10.0
	Lime	45.0
	Carbon dioxide	16.0
	Carbonation temperature	130-135°F
10	Carbonation time	90 minutes

Results after filtration and stripping

	TBN	399
15	Calcium sulfonate, wt%	18.8
	Kinetic viscosity at 100°C, cST	224.

Table 3, below, shows the results of carbonating a 50/50 parts by weight mixture of the above mentioned natural and synthetic sulfonic acid with an initial temperature of 135°F and controlling the exotherm to maintain the reaction below 145°F.

Table 3

	<u>Charge</u>	<u>wt. %</u>
25	Mixed sulfonic acid	17.7
	Synthetic sulfonate	1.0
	Oil	45.5
	Crude heptane	65.2
30	Methanol	10.0
	Lime	45.0
	Carbon dioxide	16.0
	Carbonation temperature	135-145° F
	Carbonating time	90 minutes.

35

Results after filtration and stripping

5	TBN	409
	Calcium sulfonate, wt%	19.2
	Kinetic viscosity @ 100°C, cST	65.5

Table 4, below, shows the results of carbonating a 50/50 parts by weight mixture of the
 10 above mentioned natural and synthetic sulfonic acid with an initial reactor temperature of 110°F
 and controlling the exotherm to maintain the reaction below 115°F.

Table 4

15	<u>Charge</u>	<u>wt. %</u>
	Mixed sulfonic acid	17.7
	Synthetic sulfonate	1.0
	Oil	45.5
20	Crude heptane	65.2
	Methanol	10.0
	Lime	45.0
	Carbon dioxide	16.0
	Carbonation temperature	110-115°F
25	Carbonating time	90 minutes.

Results after filtration and stripping

	TBN	400.1
30	Calcium sulfonate, wt%	18.0
	Kinetic viscosity at 100°C, cST	275.

Examples 1-4 demonstrate that by closely controlling the reactor temperature during
 carbonation at temperatures between 110° to 140°F and preferably between about 110° to 125°F,
 35 a 400 TBN overbased calcium sulfonate with an inherent high viscosity is produced. It was
 found that the use of this high viscosity overbased sulfonate yields a lower cost marine cylinder
 oil, as demonstrated in the following Example 5.

5

EXAMPLE 5Marine Oil Blends

10 Overbased calcium sulfonate products of 405 TBN were prepared by changing process temperature conditions to obtain an 80 cST at 100°C product and a 260 cST at 100°C product of the present invention. These overbased calcium sulfonates were evaluated in typical marine cylinder oil blends. The blends were made to 70 TBN. The final viscosity of the blends was 19.5 cST at 100°C. This was achieved by using combinations of a 500 SUS viscosity solvent neutral
 15 oil and a 3000 SUS at 100°F viscosity bright stock oil. The results of such blends are summarized in Table 5.

Table 5

20	<u>Composition</u>	<u>Weight %</u>	
	Solvent neutral oil, 500 SUS at 100°F	44.6	40.0
	Bright stock oil, 3000 SUS at 100°F	32.9	37.5
	405 TBN calcium sulfonate,	8.7	-
25	260 cSt at 100°C		
	405 TBN calcium sulfonate,	-	8.7
	80 cST at 100°C		
	255 TBN Oloa219 (phenate),	13.8	13.8
	400 cST at 100°C		

30

(Oloa 219 is available from the Oronite Div., Chevron USA, Inc., Richmond, California.)

Results

35

TBN	70	70
Viscosity at 100°C, cST	19.5	19.5.

5

This comparison of marine oil blends illustrates that by using a high viscosity overbased calcium sulfonate instead of a low viscosity overbased calcium sulfonate there is a reduction of the bright stock oil by 12.1% by weight with the viscosity of the marine cylinder oil blend maintained at 19.5 cST at 100°C.

10

EXAMPLE 6

Marine Cylinder Oil Blends

15 400 TBN calcium sulfonates and calcium phenates of different viscosities were blended into marine cylinder oil blends to 70 TBN and 19.5 cST at 100°C viscosity. The impact of the viscosity of the overbased phenate is shown in Table 6.

Table 6

20

	<u>Composition</u>	<u>Weight %</u>		
	Solvent neutral oil 500 SUS at 100°F	41.4	43.5	45.6
	High viscosity oil 3300 SUS at 100°F	41.3	39.2	37.1
25	400 TBN calcium sulfonate, 76 cST at 100°C	8.7	8.7	8.7
	400 TBN calcium phenate, 164 cST at 100°C	8.6	-	-
	400 TBN calcium sulfonate, 314 cST at 100°C	-	8.6	-
30	400 TBN calcium phenate, 495 cST at 100°C.	-	-	8.6

Results

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TBN	69.5	69.8	69.6
Viscosity, cSt at 100° C	19.4	19.5	19.5.

5

As illustrated in Examples 5 and 6, the present invention provides a marine cylinder oil with a viscosity of at least about 15 to 25 cST at 100°C, with reductions of more than about 12 and up to 16% by weight of the costly high viscosity or bright stock oil by the use of increased or high viscosity detergents.

10

Whereas the prior art was compelled to include high amounts of costly high viscosity oil in marine oils, this need is substantially reduced by the inherent high viscosity overbased detergents of the present invention.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A marine cylinder oil composition comprising a lubricating base oil and an overbased detergent component, the composition having a TBN of 50-90, and the
5 detergent component comprising an overbased calcium sulfonate having a viscosity of at least 180 mm²/s (180 cST) at 100°C and a TBN of about 400 or more.
2. A marine cylinder oil composition as in claim 1, wherein the overbased detergent component further comprises a calcium phenate having a viscosity of at least 200 mm²/s (200 cST) at 100°C.
- 10 3. A marine cylinder oil composition as in claim 2 wherein the calcium phenate has a viscosity of at least 240 mm²/s (250 cST) at 100°C.
4. A marine cylinder oil composition as in claim 3 wherein the calcium phenate has a TBN of about 400.
5. A marine cylinder oil composition as in claim 1 wherein the composition
15 has a viscosity of 15 to 25 mm²/s (15 to 25 cST) at 100°C.
6. A marine cylinder oil composition as in claim 1 wherein the overbased detergent component is present in an amount of 2-23% by weight of the composition.
7. A marine cylinder oil composition as in claim 6 wherein the detergent
20 component consists of said overbased calcium sulfonate, and is present in an amount of 10 to 20% by weight of the composition.
8. A marine cylinder oil composition as in claim 6 wherein the detergent component is present in an amount of 10 to 25% by weight of the composition and comprises said overbased calcium sulfonate and a calcium phenate having a viscosity of at least 250 mm²/s (250 cST) at 100°C.
- 25 9. A marine cylinder oil composition as in claim 1 further comprising at least 40% by weight of the composition of a solvent neutral oil having a viscosity of no more than about 195 mm²/s at 40°C (900 SUS at 100°F).
10. A marine cylinder oil composition as in claim 9 wherein said solvent neutral oil is present in an amount of at least 80% by weight of the composition.
- 30 11. A marine cylinder oil composition as in claim 1 wherein the overbased calcium sulfonate is a product prepared by overbasing a sulfonic acid, at least 50% of the sulfonic acid being natural sulfonic acid.

12. A marine cylinder oil composition as in claim 11 wherein at least 80% of said sulfonic acid is natural sulfonic acid.

13. A marine cylinder oil composition as in claim 11 wherein the composition has a viscosity of 15 to 25 mm²/s (15 to 25 cST) at 100°C.

5 14. A method of formulating an oil composition having a composition viscosity suitable for use as a marine cylinder oil and a composition TBN in the range of 50 to 90, wherein the composition comprises:

- a) a blend of lubricating oil having a viscosity of at least 430 mm²/s at 40°C (2000 SUS at 100°F) and solvent neutral oil having a viscosity of no more
10 than 195 mm²/s at 40°C (900 SUS at 100°F), the solvent neutral oil being present in the composition in an amount of at least 40% by weight of the composition and
- b) an overbased detergent component comprising an overbased calcium sulfonate having a TBN of about 400 or more and a viscosity of at least 180
15 mm²/s (180 cST) at 100°C in an amount effective to provide said composition TBN,

the method comprising selecting the amount of said lubricating oil to produce said predetermined composition viscosity in accordance with a predetermined inversely commensurately proportional relationship between the amount of said lubricating oil
20 and the viscosity of the detergent.

15. A method as in claim 14 wherein the overbased detergent component further comprises a calcium phenate having a viscosity of at least 200 mm²/s (200 cST) at 100°C.

16. A method as in claim 15 wherein the calcium phenate has a viscosity of at
25 least 250 mm²/s (250 cST) at 100°C.

17. A method as in claim 16 wherein the calcium phenate has a TBN of about 400.

18. A method as in claim 14 wherein the composition is formulated to a viscosity of 15 to 25 mm²/s (15 to 25 cST) at 100°C.

30 19. A method as in claim 14 wherein the overbased detergent component is present in an amount of 2-23% by weight of the composition.