

DIESEL ENGINE LUBRICANT COMPOSITION

This invention relates to lubricants suitable for use in diesel engines and to a
5 method of controlling the viscosity of such lubricants in the presence of soot.

Internal combustion engines usually function by the combustion of fuels which in
turn generates the power needed to propel vehicles. In the case of a diesel engine, the
fuel is a diesel fuel and the combustion thereof generally results in emissions from the
10 exhausts of such vehicles which comprise three main components. These are: soot,
particulate matter and nitrogen oxides (the latter will hereafter be abbreviated as NOx for
convenience). Of these, soot is generally formed as a result of incomplete combustion of
the fuel. Soot adversely affects the performance of lubricants by increasing their
viscosity (by accumulation of soot in the lubricant) and by causing wear. Moreover, it is
15 important that the presence of soot does not increase the viscosity of the lubricant to
undesirably high levels for it is also important to maintain the viscosity within the normal
grades in order to enable quick and clean drainage of the engine during servicing. The
formation of soot may be alleviated to a significant extent by operating the diesel engine
at relatively higher temperatures. However, the higher temperatures whilst mitigating the
20 formation of soot also result in the formation of increased amounts of particulate matter
and NOx. If, however, the engine temperature is lowered, incomplete combustion ensues
and whilst this reduces the amount of particulate matter and NOx formed in the
emissions, it also substantially increases the amount of soot generated. The soot so
formed can manifest itself in two ways. It can either appear as a thick black smoke
25 emitted from the exhaust of the vehicle or can be controlled by absorption or improved
dispersion of the same in the lubricant used in such engines. In view of the stringent
environmental regulations to control the emission from vehicle exhausts, it would be
preferable to retain soot in the engine lubricant. This method, however, presents a
different problem. As the soot builds up in the lubricant, the latter becomes
30 more and more viscous and upon reaching a critical value can cause gelation of the
lubricant and may eventually cause seizure of the engine. Several methods have been
tried to alleviate this problem including the use of one or more of dispersants, metal salts
and solvents which may be ethers, esters and the like. However, none of these have
resolved the problem satisfactorily.

The object of the present invention is to devise a method of mitigating the problem of the rise in viscosity of the lubricant due to the presence of soot by maximising the period for which the soot remains in the lubricant in an absorbed or well dispersed state thereby controlling the rise in the absolute viscosity of the lubricant for as long as is possible, i.e. minimising the increase in viscosity of the lubricant containing the absorbed/dispersed soot for longer than has been possible hitherto, within the desired ranges.

It has now been found that the problem outlined above can be mitigated by adding a suitable ester to the lubricant used in specified concentrations.

Accordingly, the present invention provides a diesel engine lubricant composition comprising a base stock of diesel lubricating viscosity other than synthetic phthalate esters and a dispersant characterised in that said composition also contains at least one phthalate ester in an amount of less than 5% by weight of the composition, said ester being capable of controlling the viscosity of the lubricant in the presence of soot formed due to incomplete combustion of the fuel.

The diesel engine lubricant may comprise as base stock a mineral oil, or a synthetic base stock other than phthalate esters, such as eg a polyalpha olefin, or a combination or blend of such base stocks. A mineral oil base stock which may be hydroisomerised or hydrocracked is preferred. The final lubricant compositions will generally meet standard engine oil viscosity grades including *inter alia*, 0W-20, 5W-20, 5W-30, 10W-30, 10W-40, 15W-40 and 15W-50

A dispersant is present in the compositions of the present invention to aid in the dispersancy of any soot and other particles formed in the engine and to thereby form a well dispersed suspension of such particles in the lubricant. The dispersants minimise the risk of agglomeration of the soot particles and also prevent sludge formation or flocculation of the suspended particles. Examples of dispersants that may be used in the compositions of the present invention include *inter alia* high molecular weight succinates such as e.g. polyisobutenyl succinates and the reaction products thereof with amines, especially polyamines to form the corresponding polyisobutenyl succinimides, and salts thereof such as eg the borated salts, and borated amino-phenol/formaldehyde condensates.

The dispersants are suitably used in an amount ranging from about 6-10% by weight based on the total weight of the lubricant composition, preferably from about 4-8% by weight.

5 The phthalate ester(s) chosen for this purpose have to be miscible with the base stock. With this proviso, the phthalate esters which can be used in the present invention can be esters of phthalic acid which have the carboxyl groups in the 1,2- (ortho), 1,3- (meta) or 1,4-(para) positions of the benzene nucleus. The esters are suitably derivable from monohydric alcohols having from 6-20 carbon atoms, preferably from 8-12 carbon
10 atoms and are most preferably monohydric alcohols which have 9 or 10 carbon atoms. More specifically, esters of phthalic acid and nonyl or iso-nonyl alcohols are most preferred. Of the various isomers of phthalic acid, esters of terephthalic acid are preferred.

15 The phthalate esters are suitably present in the lubricant composition in an amount which is less than 5% by weight, suitably less than 1% by weight, preferably from 0.05-0.99% by weight and more preferably from 0.1-0.6% by weight, eg from 0.3 to 0.5% by weight. The presence of the phthalate esters in the compositions of the present invention enable soot to be better dissolved and/or dispersed within the lubricant thereby
20 minimising agglomeration thereof and hence controlling the viscosity of the lubricant by maintaining it within desired levels. These desired levels will vary with the nature of the fuel combusted and the engine oil used, the engine size and the operating conditions employed. For a typical XUD11BTE passenger car engine test, the increase in viscosity due to soot is suitably no more than 125% of its initial value.

25 The lubricant compositions of the present invention can be prepared by blending the ester with the base stock along with the other ingredients using conventional lubricant blending techniques.

30 The lubricant compositions of the present invention may contain in addition, conventional additives such as e.g. anti-oxidants, viscosity index improvers, extreme-pressure agents, friction modifiers, corrosion inhibitors, emulsifying aids, pour point depressants, detergents, anti-wear, anti-foams and the like.

The performance of the additives of the present invention was tested by the following method(s) which involve the use of the industry standard test XUD 11BTE (CEC L-56-T-95).

5 The present invention is further illustrated with reference to the following Examples:

EXAMPLE:

10 The performance of a lubricant composition suitable for use in a passenger car diesel engine was evaluated for the ability of the phthalate esters of the present invention to control the viscosity thereof according to the industry standard test XUD 11BTE (CEC L-56-T-95) by performing the test on compositions with and without the phthalate esters therein.

15 The lubricant was a 5W-30 grade (ex Esso), using a mixture of base stocks including a synthetic ester component and a typical group III base stock. A monofunctional OCP viscosity modifier was used. The detergent inhibitor package (DI) contains standard lubricant additives, namely detergent, dispersant, antiwear and antioxidant additives.

20 In one formulation, the group III basestock was reduced by 3% by weight and di-isononyl phthalate ester (JAY-DINP, ex Exxon Chemicals) was added at 3% by weight level.

25 The XUD 11BTE engine test operated for 75 hours in a soot producing mode under a set of operating conditions. The details of this engine test are given in the industry procedure referred to above, ie CEC-L-56-T-95. The kinematic viscosity of the lubricant at 100°C is measured as a function of time and soot (formed and dispersed) using the standard KV₁₀₀ procedure. The viscosity of the lubricant at 3% soot concentration was chosen to reflect end of test conditions.

30 The Tables below show the materials used and the performance of the two test oils. In these Tables, the following abbreviations have been used:

JAY-DINP	-	Di-isononyl phthalate (ex Exxon Chemicals)
DURASYN®-61	-	A polyalpha olefin (ex Albamaru)
35 MARCOL®-172	-	A white mineral oil (ex Esso)
YUBASE®-4	-	A group III base stock having a viscosity of 4 cSt at 100°C

- PTN-8002 - A viscosity index improver which is an olefin copolymer containing pour point depressant
- DI - A detergent inhibitor package comprising calcium sulphonate detergent, a polyisobutenyl succinimide dispersant, a secondary zinc dithiophosphate antiwear agent, mixture of phenol and amine antioxidants, rust inhibitors and anti-foaming agent.

TABLE 1 - Lubricant Compositions

	COMPONENT (wt%)					
	JAY-DINP	DURASYN-61	MARCOL-172	YUBASE-4	PTN-8002	DI
Example 1 (Comparative)	0	29.5	20	30	8	12.5
Example 2 (Invention)	3	29.5	20	27	8	12.5

The performance of these lubricant compositions in a diesel engine were then tested using the XUD 11BTE engine test described above. The results are given in Table 2 below.

TABLE 2 - Test Results

INTEGERS TESTED	PRODUCTS 5W-30 GRADE OILS	
	Example 1 (Comparative)	Example 2 (Invention)
Absolute Viscosity increase (mm ² /s) at 3% soot	40	23
Sludge Merits	9.0	9.3
Piston Merits	44	51
Soot (%w/w)	4.3	3.6

The above results show that the addition of 3% phthalate ester (JAY-DINP) significantly reduces the absolute viscosity increase. At the same time, both sludge control and piston cleanliness are improved as shown in the sludge and piston merit results above.

CLAIMS:

1. A method of operating a diesel engine lubricated by a lubricant composition to control the rate of rise in viscosity of the composition due to the presence of soot therein, which method comprises lubricating the engine with a diesel engine lubricant composition comprising: (a) a base stock other than synthetic phthalate esters; (b) a dispersant; and (c) at least one phthalate ester in an amount less than 5% by weight of the lubricant composition.
2. The method of claim 1 wherein the phthalate ester is selected from one or more of the esters of phthalic acid which have the carboxyl group in the 1,2- (ortho), 1,3- (meta), or 1,4- (para) positions, and monohydric alcohols having 6 to 20 carbon atoms.
3. The method of claim 2 wherein the monohydric alcohol is nonyl alcohol or isononyl alcohol.
4. The method of any preceding claim wherein the phthalate ester is a terephthalate.
5. The method of any preceding claim wherein the phthalate ester is present in the lubricant composition in an amount less than 1% by weight based on the composition.
6. The method of any preceding claim wherein the dispersant is selected from high molecular weight succinates, the reaction products thereof with amines, succinimides, salts thereof, borated salts thereof, and borated amino-phenol/formaldehyde condensates.
7. The method of any preceding claim wherein the dispersant is present in the composition in an amount in the range of from 6 to 10% by weight based on the weight of the composition.
8. The method of any preceding claim wherein the composition comprises as base stock a mineral oil, a synthetic base stock other than phthalate esters, or a combination or blend of such base stocks.
9. The use of at least phthalate ester in an amount less than 5% by weight, based on the total weight of a diesel lubricant composition comprising a base stock (other than synthetic phthalate esters), to control the rise in viscosity of the composition due to the presence of soot therein during operation of a diesel engine lubricated by the composition.