



US 20110071062A1

(19) **United States**(12) **Patent Application Publication**
Jeong et al.(10) **Pub. No.: US 2011/0071062 A1**(43) **Pub. Date: Mar. 24, 2011**(54) **LONG-LIFE GASOLINE ENGINE OIL
COMPOSITION**(75) Inventors: **Do-Kon Jeong**, Gyeongju (KR);
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Seoul (KR)(21) Appl. No.: **12/752,347**(22) Filed: **Apr. 1, 2010**(30) **Foreign Application Priority Data**

Sep. 21, 2009 (KR) 10-2009-0089250

Publication Classification(51) **Int. Cl.**
C10M 169/04 (2006.01)(52) **U.S. Cl.** **508/365**(57) **ABSTRACT**

The present invention provides a long-life gasoline engine oil composition, which contains a hydrogenated styrene-diene compound, zinc alkyldithiophosphate, monoalkyl molybdenum dithiocarbamate, polyol ester, a hindered phenol antioxidant, and a base oil. With this composition, vehicle fuel efficiency can be improved, oxidation stability can be increased, and the life span of engine oil can be extended.

LONG-LIFE GASOLINE ENGINE OIL COMPOSITION

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims under 35 U.S.C. §119(a) the benefit of Korean Patent Application No. 10-2009-0089250 filed Sep. 21, 2009, the entire contents of which are incorporated herein by reference.

BACKGROUND

[0002] (a) Technical Field

[0003] The present disclosure relates to a long-life gasoline engine oil composition that can extend oil change intervals.

[0004] (b) Background Art

[0005] The life span of engine oil is affected by the deterioration in performance due to oxidation, by the production of sludge due to friction and wear, and by the deterioration itself. Since the engine oil is used at high and low pressures for a long time, the life span of engine oil is reduced by the production of sludge due to oxidation, thermal decomposition, thermal polymerization, etc. Therefore, an appropriate antioxidant is used to improve the oxidation stability of engine oil.

[0006] When friction and wear occur at high temperature and in boundary lubrication, excessive heat is produced to increase the viscosity and total acid number of the engine oil and the amount of sludge produced, thus reducing the life span of the engine oil. Therefore, although an anti-wear additive is used to prevent friction and wear, when the engine oil is used under severe conditions, a viscosity index improver used in the engine oil is deteriorated to rupture the oil film, which results in excessive friction and wear. Moreover, the anti-wear additive would be exhausted during long time use, which also results in excessive friction and wear.

[0007] An improvement of fuel efficiency with the use of engine oil may be achieved by reducing the drag torque of the engine and the friction at sliding sections of the engine. Although the drag torque of the engine can be reduced when the viscosity of the engine oil is reduced, the friction and wear at sliding sections may increase. Therefore, in order to improve the fuel efficiency by reducing the viscosity, it is necessary to use an additive which reduces the occurrence of friction and wear in the engine.

[0008] A typically used friction modifier is zinc alkyldithiophosphate, and a molybdenum additive is used at the same time. However, only with the use of the molybdenum additive, the effect and durability of friction reduction are reduced at low temperature.

[0009] The above information disclosed in this Background section is only for enhancement of understanding of the background of the invention and therefore it may contain information that does not form the prior art that is already known in this country to a person of ordinary skill in the art.

SUMMARY OF THE DISCLOSURE

[0010] In one aspect, the present invention provides a gasoline engine oil composition which contains a hydrogenated styrene-diene compound, zinc alkyldithiophosphate, monoalkyl molybdenum dithiocarbamate, polyol ester, a hindered phenol antioxidant, and a base oil.

[0011] It is understood that the term "vehicle" or "vehicular" or other similar term as used herein is inclusive of motor

vehicles in general such as passenger automobiles including sports utility vehicles (SUV), buses, trucks, various commercial vehicles, watercraft including a variety of boats and ships, aircraft, and the like, and includes hybrid vehicles, electric vehicles, plug-in hybrid electric vehicles, hydrogen-powered vehicles and other alternative fuel vehicles (e.g. fuels derived from resources other than petroleum). As referred to herein, a hybrid vehicle is a vehicle that has two or more sources of power, for example both gasoline-powered and electric-powered vehicles.

[0012] The above and other features of the invention are discussed infra.

DETAILED DESCRIPTION

[0013] Hereinafter reference will now be made in detail to various embodiments of the present invention, examples of which are illustrated in the accompanying drawings and described below. While the invention will be described in conjunction with exemplary embodiments, it will be understood that present description is not intended to limit the invention to those exemplary embodiments. On the contrary, the invention is intended to cover not only the exemplary embodiments, but also various alternatives, modifications, equivalents and other embodiments, which may be included within the spirit and scope of the invention as defined by the appended claims.

[0014] The present invention provides an engine oil composition which contains 2 to 10 wt % of a hydrogenated styrene-diene compound, 0.05 to 5 wt % of zinc alkyldithiophosphate, 0.5 to 2 wt % of monoalkyl molybdenum dithiocarbamate, 0.2 to 2 wt % of polyol ester, 0.05 to 1 wt % of a hindered phenol antioxidant, and 70 to 90 wt % of a base oil having a kinematic viscosity of 3 to 10 cSt at 100° C. The monoalkyl molybdenum dithiocarbamate contains 8 to 15 wt % of molybdenum and 10 to 12 wt % of sulfur, and the polyol ester contains at least one selected from the group consisting of neopentylglycol, trimethylolpropane, and pentaerythritol.

[0015] Moreover, the base oil contains 0.1 wt % or less of an aromatic component and has a viscosity index above 120.

[0016] The hydrogenated styrene-diene compound used as a viscosity index improver can be prepared by copolymerizing styrene and butadiene and hydrogenating unsaturated copolymers and typically used in engine oil together with olefin copolymer (OCP) and polymethacrylate (PMA). In the present invention, a base oil (VHVI base oil) having a shear stability index (SSI) of 5 to 10 can be used as a diluent solvent for polymer materials.

[0017] Important properties of the viscosity index improver include viscosity increasing performance, low-temperature performance, and shear stability. Moreover, the viscosity index improver should generate less harmful by-products and have excellent thermal and oxidation stability. The viscosity increasing performance represents the increase in viscosity at 100° C. with the addition of 0.1 wt % of polymer, and the higher the better. The low-temperature performance represents the viscosity at low temperature measured typically by a cold cranking simulator, and the lower the better. The shear stability represents the permanent viscosity decrease by percentage after thirty cycle operations in a Bosch injector, and the smaller the better.

[0018] The hydrogenated styrene-diene compound as a viscosity index improver has excellent viscosity increasing performance and shear stability compared to olefin copolymer and polymethacrylate. Therefore, due to the excellent viscos-

ity increasing performance, the viscosity increases at high temperature even with a small amount of polymer to strengthen the oil film, which helps to prevent friction and wear. Moreover, the excellent shear stability prevents the viscosity index improver polymer from being degraded when the engine is operated under severe conditions for a long time, which reduces the permanent viscosity decrease due to the degradation of polymer and maintains the performance of engine oil for a long time, thus ensuring a long life of the engine oil.

[0019] The zinc alkyldithiophosphate can be used as an anti-wear agent. Here, the zinc alkyldithiophosphate includes primary and secondary types according to the structure of an alkyl group, in which the primary type is excellent in terms of thermal decomposition temperature and the secondary type is excellent in terms of load resistance performance. Therefore, the ratio of the primary type and the second type is preferable about 1:2, and the amount of zinc alkyldithiophosphate used is preferably 0.05 to 5 wt %. If the amount of zinc alkyldithiophosphate used is less than 0.05 wt %, the anti-wear performance is degraded, whereas if it exceeds 5 wt %, sludge may be produced.

[0020] The monoalkyl molybdenum dithiocarbamate used as a molybdenum additive reacts with metal in boundary and extreme pressure lubrication to form a film in the form of molybdenum disulfide, which reduces the friction coefficient, thus serving as a friction reducer. The molybdenum additive is an organic molybdenum additive in which an alkyl group has a carbon number of 8 to 13. Here, highly-concentrated monoalkyl molybdenum dithiocarbamate containing 8 to 15 wt % of molybdenum and 10 to 12 wt % of sulfur was used. The amount of monoalkyl molybdenum dithiocarbamate used is preferably 0.5 to 2 wt %. If the amount of monoalkyl molybdenum dithiocarbamate used is less than 0.5 wt %, the friction reducing effect decreases, whereas if it exceeds 2 wt %, it is not well dissolved during the manufacturing of engine oil and sludge may be produced at high temperature during the use thereof.

[0021] The polyol ester can be used as an ester additive. The polyol ester has excellent thermal stability, load resistance performance, and solubility to engine oil. The polyol ester may include neopentylglycol, trimethylolpropane, and pentaerythritol. The amount of polyol ester used is preferably 0.2

to 2 wt %. If the amount of polyol ester used is less than 0.2 wt %, the friction reducing effect decreases, whereas if it exceeds 2 wt %, it is not well dissolved during the manufacturing of engine oil and a sealing material may swell.

[0022] The antioxidant may contain at least one selected from the group consisting of a chain reaction terminator, a peroxide decomposer, a metal deactivator, and a mixture thereof. Preferably, the chain reaction terminator which prevents the oxidation at the initial stage may be mainly used. The chain reaction terminator may include hindered phenols such as 2,6-di-tertiary-butyl-para-cresol and 4,4'-methylenebis(6-tertiary-butyl-ortho-cresol), and aromatic amines such as dioctyldiphenylamine and phenyl-alpha-naphthalene. In the present invention, 2,6-di-tertiary-butyl-para-cresol can be used as the hindered phenol antioxidant in an amount of 0.05 to 1 wt %. If the amount of 2,6-di-tertiary-butyl-para-cresol used is less than 0.05 wt %, the antioxidative effect is reduced, whereas if it exceeds 1 wt %, the performance is not improved any more.

[0023] As the base oil used in the present invention, one or two types of mineral oils having a kinematic viscosity of 3 to 10 cSt at 100° C. can be used. The mineral oil represents the base oil containing 0.1 wt % or less of an aromatic component and having a viscosity index 120 or higher. Here, since the aromatic component is readily oxidized at high temperature, the lower the aromatic content, the more excellent the oxidation stability. Moreover, when the viscosity index is 120 or higher, the change in viscosity due to the temperature is reduced, thus ensuring excellent performance of the engine oil against the change in temperature. In the present invention, one or two types of mineral oils were used in an amount of 70 to 90 wt %.

EXAMPLES

[0024] The following examples illustrate the invention and are not intended to limit the same.

Example 1

Preparation of Gasoline Ermine Oil

[0025] Gasoline engine oil was prepared with the components listed in table 1:

TABLE 1

(Unit: wt %)				
Classification	Name of Compound	Example 1	Example 2	Example 3
Base oil	High viscosity index base oil	85	88.8	80.5
Viscosity index improver	Hydrogenated-styrene-diene	5	—	—
	Olefin copolymer	—	3	12
Anti-wear agent	Zinc alkyldithiophosphate	2	2	3
Molybdenum additive	Monoalkyl molybdenum dithiocarbamate	0.8	—	—
Ester additive	Polyol ester	1	—	—
Antioxidant	2,6-di-tertiary-butyl-para-cresol	0.5	0.5	0.3
Ashless dispersant	Polyisobutylene succinimide	5.0	5.0	4.0

TABLE 1-continued

(Unit: wt %)				
Classification	Name of Compound	Example 1	Example 2	Example 3
Antifoaming agent	Polysiloxane	0.2	0.2	0.2
Anticorrosive agent	Benzotriazole	0.5	0.5	—

- (1) Base oil: Ultra-S base oil available from S-Oil
 (2) Hydrogenated-styrene-diene: available from Infinium
 (3) Zinc alkyldithiophosphate (ZnDTP): available from Lubrizo
 (4) Monoalkyl molybdenum dithiocarbamate (MoDTC): SC525 available from Adeka
 (5) Polyol ester: P-1973 available from Uniqema
 (6) 2,6-di-tertiary-butyl-para-cresol: available from Ciba
 (7) Polyisobutylene succinimide: available from Lubrizo
 (8) Polysiloxane: available from Shin-Etsu
 (9) Benzotriazole: available from Lubrizo

Comparative Example 1

API SM 5W-20 Gasoline Engine Oil

[0026] Commercially available API SM 5W-20 gasoline engine oil was used, and its components are shown in the above table 1.

Comparative Example 2

ACEA A3/B3 5W-40 Gasoline Engine Oil

[0027] Commercially available ACEA A3/B3 5W-40 gasoline engine oil was used, and its components are shown in the above table 1.

Test Example 1

Evaluation of High-Temperature Oxidation Stability

[0028] Under the engine test conditions of the following table 2, an engine dynamometer test was carried out to evaluate the oxidation stability and high-temperature deposit forming tendencies of engine oil, and the results are shown in the following table 3:

TABLE 2

	Classification						
	Stage 3						
	Stage 1 Warm	State 2 Warm	Phase 1 192 hr. (3 steps × 48 times)			Phase 2	Stage 4 Phase 3
			120 min.	72 min.	48 min.		
Duration	2 min.	8 min.	120 min.	72 min.	48 min.	56 hr.	5 min.
Rotational Speed (rpm)	1,500	3,200	4,300 ± 15	4,300 ± 15	Idle	4,300	Idle
Load (Nm)	20	100	WOT	75 ± 0.5	0	75	0
Oil Temp. (° C.)	—	—	133 ± 3	130 ± 3	50 ± 3	130	—
Coolant out (° C.)	—	—	96 ± 2	96 ± 2	30 ± 2	96 ± 2	—
Temp. Intake (° C.)	—	—	25 ± 4	25 ± 4	25 ± 4	—	—
Temp. Fuel (° C.)	—	—	28 ± 2	28 ± 2	28 ± 2	—	—

TABLE 3

Classification	Example 1	Example 2	Example 3
Piston cleanliness evaluation* (rating)	8.3	6.4	8.0
Engine oil consumption amount (%)	22.3	27.8	26.2

TABLE 3-continued

Classification		Example 1	Example 2	Example 3
Total base number	Before test	9.7	7.1	11.1
(mgKOH/g)	After test	7.2	3.1	6.7
	Difference	−2.5	−4.0	−4.4
Total acid number	Before test	3.1	3.3	3.5
(mgKOH/g)	After test	4.2	5.8	5.8
	Difference	1.1	2.5	2.3

*The piston cleanliness was evaluated by CEC M-02-A-78, and the evaluation results are represented as 1 to 10, in which the higher value represents the performance is excellent since there is no deposit.

The total acid number was measured by ASTM D-664.

The total base number was measured by ASTM D-2896.

[0029] In the Examples of the present invention, the amount of piston deposits generated and the engine oil consumption amount were significantly reduced compared to the Com-

parative Examples. Moreover, the total base number and the total acid number were less changed.

Test Example 2

Evaluation of Fuel Efficiency

[0030] The Sequence VIB (STM D-6837) test was carried out to measure the fuel efficiency of engine oils, and the results are shown in the following table 4:

TABLE 4

Results of ASTM Fuel Efficiency Engine Oil Dynamometer Test			
Classification	Example 1	Comparative Example 1	Comparative Example 2
Initial fuel efficiency (after 16 hours) Improvement rate (%)*	0.6	1.0	-1.2
Fuel efficiency durability (after 96 hours) Improvement rate (%)*	0.4	0.5	-1.7

*The fuel efficiency improvement rate was evaluated by comparing the measured fuel consumption amount with the fuel consumption amount with respect to the reference engine oil (API SL/GF-3 5W-20).

[0031] In Example 1 of the present invention, the viscosity was lower than that of Comparative Example 1 and higher than that of Comparative Example 2, and thus the fuel efficiency was improved in proportion to the viscosity.

[0032] However, since the viscosity level of the engine oil used as a reference for the fuel efficiency evaluation was 5W-20, it was lower than the viscosity level of 5W-30 in Example 1. However, it could be confirmed that the fuel efficiency of Example 1 was more excellent than that of the reference engine oil for the evaluation of fuel efficiency. Moreover, it could be understood that the fuel efficiency of Example 1 was improved as time went on.

[0033] As described above, according to the long-life engine oil composition of the present invention, the oxidation stability and anti-wear performance are improved to prolong

the life span of the engine oil, and as a result the deterioration of the engine oil is reduced, thus improving the fuel efficiency.

[0034] The invention has been described in detail with reference to preferred embodiments thereof. However, it will be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the appended claims and their equivalents.

What is claimed is:

1. An engine oil composition comprising:

2 to 10 wt % of a hydrogenated styrene-diene compound;

0.05 to 5 wt % of zinc alkyldithiophosphate;

0.5 to 2 wt % of monoalkyl molybdenum dithiocarbamate;

0.2 to 2 wt % of polyol ester;

0.05 to 1 wt % of a hindered phenol antioxidant; and

70 to 90 wt % of a base oil having a kinematic viscosity of 3 to 10 cSt at 100° C.

2. The engine oil composition of claim 1, wherein the monoalkyl molybdenum dithiocarbamate comprises 8 to 15 wt % of molybdenum and 10 to 12 wt % of sulfur.

3. The engine oil composition of claim 1, wherein the polyol ester comprises at least one selected from the group consisting of neopentylglycol, trimethylolpropane, and pentaerythritol.

4. The engine oil composition of claim 1, wherein the base oil comprises 0.1 wt % or less of an aromatic component and has a viscosity index 120 or higher.

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