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[54] **LUBRICANT COMPOSITIONS CONTAINING ACETAL OR KETAL DETERGENTS**

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[51] **Int. Cl.** **C10m 1/20**

[58] **Field of Search** ..... 252/56 D, 56 R, 52 R

[56] **References Cited**

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[57] **ABSTRACT**

Lubricant compositions are provided comprising an oil of lubricating viscosity and, in an amount sufficient to impart detergent properties, a carbonyl compound selected from the group consisting of acetals and ketals.

15 Claims, No Drawings

LUBRICANT COMPOSITIONS CONTAINING ACETAL OR KETAL DETERGENTS

BACKGROUND OF THE INVENTION

1. Field Of The Invention.

This invention relates to lubricant compositions and, in one of its aspects, relates more particularly to lubricant compositions which normally exhibit unsatisfactory detergent properties.

2. Description Of The Prior Art.

It is well-known that lubricant oils, intended for a wide variety of functions, such as gasoline engine lubricants and other related uses, tend to form sludge and undesirable deposits during use or storage. These conditions have therefore necessitated the introduction of various detergents or dispersants for prevention or reduction of sludge formation. In this respect, it has also been found highly desirable that such detergents exhibit nitrogen-free and ashless characteristics. As of the present time, conventional detergents may be deficient in one or more of such criteria.

SUMMARY OF THE INVENTION

It has now been found that improved lubricant compositions can be provided comprising an oil of lubricating viscosity and, in an amount sufficient to impart detergent properties, a carbonyl compound selected from the group consisting of acetals and ketals. These carbonyl compounds (i.e., acetals and ketals) are non-nitrogen ashless polymeric dispersant condensation products exhibiting excellent activity in detergency bench tests.

As more particularly hereinafter described, the carbonyl compounds, employed as detergents in the novel lubricant compositions, are prepared by reacting alkenylsuccinic anhydrides with polyhydric alcohols in equimolar amounts; reacting the ester thus formed with a compound selected from the group consisting of aldehydes and ketones to form the corresponding acetal or ketal; and removing water formed during the reaction. In general, the aforementioned reaction is carried out at a temperature from about 100°C. to about 200°C. and preferably at a temperature from about 140°C. to about 180°C. For most applications the alkenylsuccinic anhydride preferably contains from about 30 to about 500 carbon atoms. Any polyhydric alcohol can be employed in the aforementioned reaction for producing the acetal or ketal and particularly preferred, and representative thereof, are trimethylol propane, pentaerythritol, glycerol, butanediol, pinacol, sorbitol, erythritol, mannitol, cyclohexanediol and glycerol mono oleate. Any aldehyde may also be employed for reaction with the ester, formed by reacting the alkenylsuccinic anhydride with the polyhydric alcohol, and particularly preferred, and representative thereof, are formaldehyde, salicylaldehyde, glyoxal, 2 ethyl hexaldehyde, butyraldehyde, octadecyl aldehyde and benzaldehyde. Any ketone may be employed for forming the desired ketal, and particularly preferred and representative thereof, are diacetone alcohol, benzoin, methyl ethyl ketone, di octyl ketone, methyl dodecyl ketone and methyl octadecyl ketone.

Any oil of lubricating viscosity can be successfully treated with the aforementioned acetals or ketals for imparting detergent properties. In general, hydrocarbon lubricating oils of varying viscosity and pour points may be employed, and particularly contemplated are

liquid hydrocarbon oils boiling within the range from about 75°F. to about 1000°F. or higher. Also, more specifically contemplated are mineral lubricating oils, of any suitable lubricating viscosity range from about 45 SSU at 100°F. to about 6000 SSU at 100°F. and, preferably, from about 50 to about 250 SSU at 210°F. Such oils may have viscosity indexes varying from below 0 to about 100 or higher. Viscosity indexes from about 70 to about 95 are preferred. The average molecular weights of these oils may range from about 250 to about 800.

As hereinbefore indicated, the lubricant composition is formulated to include the acetal or ketal in an amount sufficient to impart the desired degree of detergency. In general, in many applications the carbonyl compound (i.e., acetal or ketal) is employed in an amount from about 1 to about 10 percent, and preferably in an amount from about 2 to about 6 percent, by weight, of the total weight of the lubricant composition.

DESCRIPTION OF SPECIFIC EMBODIMENTS

The following data and examples will serve to illustrate the marked degree in detergency improvement of lubricant compositions, by employing the aforementioned acetal or ketal additives. It will be understood, however, that it is not intended that the invention be limited to the particular lubricant compositions disclosed, nor the specific acetals or ketals employed as detergents. Various modifications thereof can be employed and will be readily apparent to those skilled in the art.

EXAMPLE 1

A mixture of 900 grams (1 mol combining weight) of polybutene and 98 grams (1 mol) of maleic anhydride was stirred at a temperature of about 225°C. for a period of about 8 hours to form a polybutenylsuccinic anhydride, as employed in the following examples. In this respect, it will be noted that the polybutene employed for formation of the aforementioned polybutenylsuccinic anhydrides (as employed herein and in the following examples) possess, in general, a molecular weight from about 900 to about 5000, and preferably a molecular weight from about 900 to about 2500.

To 700 grams (0.7 mol combining weight) of the above obtained polybutenylsuccinic anhydride were added 90 grams (0.7 mol) of trimethylol propane, 6 grams para toluene sulfonic acid, as a catalyst, and 200 grams xylene as a diluent. The resulting mixture was refluxed at 140°C. for a period of about 10 hours. Formalin solution containing 21 grams (0.7 mol) formaldehyde was then added at a temperature of about 75°C. and then refluxed at a temperature of 140°C. for a period of 8 hours. The resulting reaction mixture was then neutralized by refluxing with about 50 grams of a 30 percent ammonium hydroxide solution. Filtration and topping at reduced pressure gave the final product.

EXAMPLE 2

A mixture of 700 grams (0.35 mol combining weight) of polybutenylsuccinic anhydride, 46 grams (0.35 mol) pentaerythritol, 6 grams para toluene sulfonic acid, and 150 grams xylene diluent was refluxed at about 160°C. for about 10 hours. Formalin solution containing 10.5 grams (0.35 mol) was added at 75°C. and refluxed at 170°C. until evolution of water ceased. The mixture was neutralized by refluxing with 35 grams of a 30 per-

cent ammonium hydroxide solution. Filtration and topping at reduced pressure gave the final product.

EXAMPLE 3

A mixture of 2274 grams (1.5 mols combining weight) of a polybutenylsuccinic anhydride, 381 grams (1.5 mols) of a di pentaerythritol, and 200 grams xylene diluent was refluxed at 220°C. until evolution of water ceased. The mixture was cooled to 60°C. and 6 grams para toluene sulfonic acid, and 113 grams (4.5 mols) formaldehyde was added along with more xylene. The reaction mixture was then refluxed at about 160°C. until evolution of water ceased. The mixture was neutralized by refluxing with 35 grams of a 30 percent ammonium hydroxide solution. Filtration and topping at reduced pressure gave the final product.

EXAMPLE 4

A mixture of 2400 grams (1.0 mol combining weight) of a polybutenylsuccinic anhydride, 136 grams (1.0 mol) pentaerythritol, 12 grams para toluene sulfonic acid, and 200 grams xylene was refluxed at 175°C. for about 10 hours. Formalin solution containing 30.0 grams formaldehyde was added with more xylene diluent. The mixture was refluxed at about 160°C. until evolution of water ceased. The mixture was then neutralized by refluxing with 50 grams of a 30 percent ammonium hydroxide solution. Filtration and topping at reduced pressure gave the final product.

EXAMPLE 5

A mixture of 850 grams (0.5. mol combining weight) of a polybutenylsuccinic anhydride, 136 grams (1.0 mol) pentaerythritol, 7 grams para toluene sulfonic acid, and 200 grams xylene was refluxed at about 180°C. for about 10 hours. Formalin solution containing 60 grams (2.0 mol) formaldehyde was added with toluene diluent. The mixture was then refluxed by gradually raising the temperature to about 190°C. The mixture was neutralized by refluxing with 35 grams of a 30 percent ammonium hydroxide solution. Filtration and topping at reduced pressure gave the final product.

EXAMPLE 6

A mixture of 832 grams (0.5 mol combining weight) of a polybutenylsuccinic anhydride, 68 grams (0.5 mol) pentaerythritol, 6 grams para toluene sulfonic acid, and 200 grams xylene was refluxed at about 175°C. for about 10 hours. 61 grams (0.5 mol salicylaldehyde was added with toluene diluent and the mixture refluxed at about 175°C. for 10 hours. The mixture was neutralized by refluxing with 50 grams of a 30 percent ammonium hydroxide solution. Filtration and topping at reduced pressure gave the final product.

EXAMPLE 7

A mixture of 832 grams (0.5 mol combining weight) of a polybutenylsuccinic anhydride, 68 grams (0.5 mol) pentaerythritol, 6 grams para toluene sulfonic acid, and 200 grams xylene was refluxed at about 175°C. for about 10 hours. 58 grams (0.5 mol) diacetone alcohol was added with toluene diluent and the mixture refluxed at about 175°C. for 8 hours. The mixture was neutralized by refluxing with 35 grams of a 30 percent ammonium hydroxide solution. Filtration and topping at reduced pressure gave the final product.

EXAMPLE 8

A mixture of 1000 grams (0.52 mol combining weight) of a polybutenylsuccinic anhydride, 70 grams (0.52 mol) pentaerythritol, 6 grams para toluene sulfonic acid, and 200 grams xylene was refluxed at 175°C. for about 10 hours. 15.1 grams (0.26 mol) glyoxal was added with toluene diluent and the mixture refluxed at 175°C. for 8 hours. The mixture was neutralized by refluxing with 40 grams of a 30 percent ammonium hydroxide solution. Filtration and topping at reduced pressure gave the final product.

EXAMPLE 9

A mixture of 800 grams (0.41 mol combining weight) of a polybutenylsuccinic anhydride, 56 grams (0.41 mol) pentaerythritol, 6 grams para toluene sulfonic acid, and 200 grams xylene was refluxed at 175°C. for about 10 hours. 87 grams (0.41 mol) benzoin and 12 grams para toluene sulfonic acid was added with toluene diluent and the mixture refluxed at 200°C. for 8 hours. The mixture was neutralized by refluxing with 100 grams of a 30 percent ammonium hydroxide solution. Filtration and topping at reduced pressure gave the final product.

The individual acetal and ketal additives of Examples 1 throught 9 were next individually blended in a base fluid comprising a mixture of conventionally refined lube oil stocks derived from a Mid-continent crude oil. This base fluid also contained, by weight, 1.3 percent of an overbased magnesium sulfonate, 1.2 percent of zinc dithiophosphate and 1.0 percent of barium dithiophosphate. The base fluid and the same base fluid containing the aforementioned individual additives were next subjected for evaluation in a diesel oil test. This test was developed to produce deposits from the oxidation of lubricating oil under conditions which closely approximate those found in the piston zone of a diesel engine. The test consists of an aluminum cylinder heated by radiant energy fron an internal heater. The surface temperature of the heater is maintained at 575°F. during the test period (140 minutes). The shaft turns slowly (2 RPM) and dips into an oil sump where it picks up a thin film of oil. This thin film is carried into the oxidation zone where heated gases (moist air at 350°F. is typically employed, however, nitrogen oxides, sulfur oxides and other mixtures can be used) form oxidation deposits. These deposits can be affected by the detergent as the test cylinder rotates into the sump. The efficiency of the detergent is rated by the color and intensity of the deposit on the shaft at the end of the test. The comparative results obtained, employing this test, are shown in the following table.

TABLE

Composition	Diesel Oil Test Conc. Wt. %	Rating at 140 Minutes
Base Fluid	0	62
Base Fluid + Example 1	3.0	81
Base Fluid + Example 2	3.0	85
Base Fluid + Example 3	3.0	79
Base Fluid + Example 4	3.0	86
Base Fluid + Example 5	3.0	88
Base Fluid + Example 6	3.0	80
Base Fluid + Example 7	3.0	81
Base Fluid + Example 8	3.0	85
Base Fluid + Example 9	3.0	82

As will be seen from the foregoing comparative data and results obtained, the acetal and ketal additives of the present invention exhibit an ability to impart outstanding detergent properties to lubricant compositions. Although the present invention has been described with preferred embodiments, it will be understood that various modifications and adaptations thereof may be resorted to without departing from the spirit and scope of the invention, as those skilled in the art will readily understand.

We claim:

1. A lubricant composition comprising a major amount of an oil of lubricating viscosity and, in an amount sufficient to impart detergent properties, a carbonyl compound selected from the group consisting of alkenylsuccinic acid-polyhydric alcohol ester acetals or ketals, wherein the alkenyl group contains at least about 30 carbon atoms.

2. A lubricant composition as defined in claim **1** wherein said carbonyl compound is present in an amount from about 1 to about 10 percent, by weight.

3. A lubricant composition as defined in claim **1** wherein said carbonyl compound is present in an amount from about 2 to about 6 percent, by weight.

4. A lubricant composition as defined in claim **1** wherein said oil of lubricating viscosity comprises a liquid hydrocarbon boiling within the range from about 75°F. to about 1000°F.

5. A lubricant composition as defined in claim **1** wherein said carbonyl compound has been prepared by reacting an alkenylsuccinic anhydride with a polyhydric alcohol in equimolar amounts; reacting the ester thus formed with a compound selected from the group consisting of aldehydes and ketones to form the corresponding acetal or ketal; and removing water formed during reaction.

6. A lubricant composition as defined in claim **5** wherein said reaction is carried out at a temperature from about 100°C. to about 200°C.

7. A lubricant composition as defined in claim **5** wherein said reaction is carried out at a temperature from about 140°C. to about 180°C.

8. A lubricant composition as defined in claim **1** wherein said alkenylsuccinic anhydride contains from about 30 to about 500 carbon atoms.

9. A lubricant composition as defined in claim **1** wherein the alcohol is trimethylol propane.

10. A lubricant composition as defined in claim **1** wherein the alcohol is pentaerythritol.

11. A lubricant composition as defined in claim **1** wherein the aldehyde is formaldehyde.

12. A lubricant composition as defined in claim **1** wherein the aldehyde is salicylaldehyde.

13. A lubricant composition as defined in claim **1** wherein the aldehyde is glyoxal.

14. A lubricant composition as defined in claim **1** wherein the ketone is diacetone alcohol.

15. A lubricant composition as defined in claim **1** wherein the ketone is benzoin.

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