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LUBRICATING OIL

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This invention relates to lubricating oil compositions and to methods for their preparation. More particularly, it relates to improved lubricating oils which are obtained by condensing long chain olefin polymers onto lubricating oil components.

A large variety of lubricating oils are produced and used in many different applications. Various additives are often used in such oils, to adjust the viscosity index, viscosity, pour point, volatility, color, and for various other purposes. Such additives are normally added to refined lubricating oils; that is, to oils from which contaminants such as sulfur and metals have been removed, and which have been hydrogenated or otherwise treated to remove unsaturates, which might cause deterioration of such oils. In addition, anti-oxidants are often added to prevent oxidation of the lubricating oil.

Various polymers, such as polyethylene, polypropylene, and polyisobutylene, are sometimes added to lubricating oils to increase the viscosity index of the base oil, or to increase its viscosity or lower its pour point. For these purposes, these additives have proved quite helpful in many instances. The polymers used are amorphous liquids or semi-solids which are soluble in the lubricating oil components and result in a substantially homogeneous mixture.

It is an object of this invention to provide a method for improving lubricating oils. It is another object to provide a method for improving lubricating oils in which long chain olefin polymers are condensed onto lubricating oil components. Other objects and their achievement in accordance with this invention will be apparent hereinafter.

According to this invention, various isoparaffinic, naphthenic, and aromatic components of lubricating oils are reacted with an alkali metal alkyl to form organo-metallic compounds. A normally gaseous alpha-olefin is then injected in the presence of a catalyst, such as titanium trichloride, whereby the olefin is polymerized to relatively high molecular weight molecules which replace the alkali metal on the organo-metallic compounds, thereby forming a copolymer of the olefin and the isoparaffinic or cyclic compound. This will have the effect of thickening the lubricating oil, and of increasing its viscosity index, as well as lowering its pour point.

Preferably the lubricating oil used has previously been refined so that sulfur and metallic components have been removed, and hydrogenated to saturate unsaturated compounds. The refined lubricating oil will contain primarily naphthenic (cycloparaffinic) and aromatic hydrocarbons in addition to isoparaffinic (tertiary carbon containing) hydrocarbons. At least some of the aromatic and cycloparaffinic rings are condensed together, so that aromatic-cycloparaffinic hydrocarbons are present. Compounds having from one to four or more rings per molecule may be present. Most of these monocyclic and polycyclic compounds have one or more paraffinic side chains of varying length, from one to about twelve carbon atoms. It is known that the presence of long side chains results in a lubricating oil having a high viscosity index and a low pour point. A large proportion of the ring compounds in lubricating oils, however, have only one to four carbon atoms in their side chains. By the process of this invention more long side chains are formed on

these components as well as on the isoparaffinic components, thereby improving the viscosity index and increasing the viscosity of the lubricating oil.

The isoparaffinic and cyclic compounds are reacted with an alkali metal alkyl to form metallated compounds. In this reaction the alkali metal replaces hydrogen in the ring compounds at reactive points, e.g., on the alpha carbon in a branch chain which is attached to the ring, and in isoparaffinic compounds, replaces hydrogen on the tertiary carbon. Several metal atoms may attach to a single molecule if a sufficient amount of the alkali metal alkyl is used, and if sufficient highly reactive points are available. The amount of alkali metal alkyl to be used is varied in accordance with the amount of reaction desired. Ordinarily at least 0.1 mole of alkali metal alkyl per mole of lubricating oil components will be used, although at times it may be desirable to use up to 5 moles per mole in order to attach alkali metal atoms at a large number of places.

Alkyl derivatives of any of the alkali metals may be used, although those of the higher molecular weight metals are more reactive. Any of the known alkyl derivatives may be used, as, for example, methyllithium, isoamyl, lithium, ethyl sodium, amyl sodium, dodecyl sodium, amyl potassium, methyl rubidium, and ethyl cesium. The reaction depends on the replacement of the weak acid component in an organo-metallic salt by a stronger acid. For example, if an excess of amyl sodium is added to a lubricating oil containing 1,2,3,4-tetramethyl benzene, sodium replaces hydrogen from each methyl group, thereby forming tetra (methyl sodium) benzene, hydrogen from the methyl group attaching to the amyl group to form pentane.

The reaction must be carried out in an atmosphere free of oxygen and water, since these materials cause rapid decomposition of the alkali metal alkyls. Low temperatures are preferably used, since the alkali metal alkyls are relatively unstable toward thermal decomposition. Room temperature is preferably used, although certain of the alkali metal alkyls may be reacted successfully at temperatures up to 200° C. Normally atmospheric pressure is used during the reaction, since the use of high pressures is not advantageous. Many of the alkali metal alkyls are solids, and these are preferably ground to a finely divided powder before adding to the lubricating oil, since a more efficient use of the material is achieved thereby. Preferably the oil is agitated during the reaction to keep the alkali metal alkyl particles dispersed therein. Reaction begins as soon as the alkali metal alkyl is added to the lubricating oil, and proceeds quite rapidly, so that normally only a short period of time—ten minutes to one hour—is required to complete the reaction.

When the above-described metallating reaction is complete, a catalyst and an alpha-olefin are added to the lubricating oil. Ethylene and propylene are the preferred alpha-olefins, although other alpha-olefins having up to about eight carbon atoms may also be used. The catalyst used is a finely divided solid halide of a metal such as zirconium, chromium, vanadium, molybdenum, or titanium. A subhalide of titanium or zirconium, such as titanium trichloride or zirconium dichloride is preferred, although the fluorides and bromides of these metals as well as of chromium, vanadium, and molybdenum are operable. A weight ratio of catalyst to lubricating oil of from 1:100 to 1:5000 may be used with good results. The higher proportions of catalyst result in a more rapid reaction. The amount of olefin used will vary depending on the amount of reaction desired with the lubricating oil. A mole ratio of olefin to lubricating oil of from about 1:10 to about 40:1 can be used with good results. Lesser amounts of olefin will not result in

a noticeable change in the properties of the lubricating oil, and greater amounts will result in the formation of excessively long side chains which would cause the lubricating oil to lose its desirable qualities.

This reaction may be carried out at room temperature and atmospheric pressure, although temperatures of from about 0° C. to about 250° C., and pressures up to about 10,000 p.s.i.g. (pounds per square inch gauge) may also be used. When normally gaseous olefins are the olefins to be polymerized, sufficient pressure is used to maintain the olefin in liquid phase. This reaction also must be carried out under oxygen-free and anhydrous conditions, since oxygen and water deactivate the catalyst. The mixture is continuously agitated to maintain a dispersion of the solid catalyst particles, since the reaction is thereby made to proceed more rapidly. The reaction normally proceeds quite rapidly and may be complete in as little as 10 minutes, although under some conditions up to 12 hours may be required.

This reaction results in the formation of long chains of carbon atoms, formed from the olefin, which are attached to the carbon atom of the carbon to metal bond. These chains may consist of from four to two hundred or more carbon atoms. The lubricating oil thus formed is washed with alcohol to remove the alkali metal, and to deactivate and remove the catalyst, and the alcohol with dissolved metals separated by any convenient means, such as by decanting. Thus the lubricating oil components have in effect been alkylated by long chain hydrocarbons, causing an improvement in the viscosity index of the lubricating oil, an increase in its viscosity, and a decrease in its pour point.

The following specific embodiment, in which "parts" refers to parts by weight, illustrates the process of this invention:

A refined lubricating oil having a viscosity at 100° F. of 107 SSU (Saybolt Seconds Universal), a viscosity at 210° F. of 39.5 SSU, and a viscosity index of 80 was analyzed and found to contain 13% aromatics with an average of 1.2 aromatic rings per molecule and 1.6 naphthene rings per molecule, with an average molecular weight of 336. The saturates contained an average of 1.6 naphthene rings per molecule and had an average molecular weight of 360. Under anhydrous and oxygen-free conditions, 300 parts of finely divided amyl sodium are added to 1000 parts of the lubricating oil, at room temperature and under a pressure of 10 p.s.i.g. of nitrogen, in a reactor fitted with a stirrer. The solution is agitated for 30 minutes, and then one part of finely divided titanium trichloride is uniformly dispersed therein.

Propylene is injected at a temperature of 70° C. and a pressure of 258 p.s.i.g. while agitation is continued. Polymerization begins immediately, as evidenced by a drop in pressure in the reactor. Additional propylene is injected from time to time to maintain the pressure and the temperature is held at approximately 70° C. After six hours, agitation is stopped, and the excess propylene vented. About 500 parts of methyl alcohol are added, and the mixture agitated for one hour. The methanol, containing dissolved titanium and sodium compounds, is then decanted. The remaining lubricating oil has a viscosity at 100° F. of 505 SSU, a viscosity at 210° F. of 65 SSU, and a viscosity index of 102. Thus, both viscosity and viscosity index are increased.

The invention claimed is:

1. A process for improving a petroleum lubricating oil containing isoparaffinic, aromatic and naphthenic components which comprises reacting said lubricating oil and an alkali metal alkyl containing from 1–12 carbon atoms under substantially anhydrous and oxygen-free conditions at a temperature in the range from ambient temperature to 200° C. whereby organo-metallic compounds of said lubricating oil components are formed, subsequently contacting the metallated oil at polymerization conditions with an alpha-olefin having from 2 to 8 carbon atoms and a polymerization catalyst selected from the group consisting of halides of titanium, zirconium, chromium, vanadium and molybdenum at a temperature in the range of from about 0° C. to about 250° C. at a pressure in the range of from about atmospheric to about 10,000 p.s.i.g. whereby the said alpha-olefin is polymerized and condenses with the lubricating oil, replacing the alkali metal.

2. A process for improving a petroleum lubricating oil containing isoparaffinic, aromatic and naphthenic components which comprises reacting said lubricating oil and from 0.1 to 10.0 moles of an alkali metal alkyl selected from the group consisting of ethyl sodium, isoamyl sodium, amyl sodium and amyl potassium under substantially anhydrous and oxygen-free conditions at a temperature in the range of from ambient temperature to 200° C. whereby organo-metallic compounds of said lubricating oil components are formed, and adding thereto from 0.1 to 40 moles per mole of lubricating oil components of an alpha-olefin having from 2 to 8 carbon atoms and a halide of a metal selected from the group consisting of titanium, zirconium, chromium, vanadium and molybdenum in a weight ratio of halide to lubricating oil of from 1:100 to 1:150 at a temperature in the range of from about 0° C. to about 250° C. and a pressure in the range of from about atmospheric to about 10,000 p.s.i.g. whereby the alphaolefin is polymerized and condenses with the lubricating oil replacing the alkali metal.

3. A process as defined by claim 2 wherein the alpha-olefin is ethylene.

4. A process as defined by claim 2 wherein the alpha-olefin is propylene.

5. A process as defined by claim 2 wherein the metal halide is titanium trichloride.

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