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2,951,041

SYNTHETIC LUBRICANT COMPOSITION

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6 Claims. (Cl. 252—34.7)

(Granted under Title 35, U.S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to synthetic lubricants and additives therefor. More particularly the invention relates to water soluble polymerized alkylene oxide oils and to additives which improve the lubricity and antioxidant characteristics of these oils so as to make them useful under extreme ambient conditions while retaining their water soluble characteristics.

This application is a continuation-in-part of Serial No. 241,380, filed August 10, 1951, now abandoned.

Improved high powered turbine type internal combustion engines have recently been developed for use in high speed underwater ordnance equipment such as submarines and torpedoes. An example of this type of engine is the hydrogen peroxide propelled engine used in submarines. This engine is combined with the conventional diesel engine with the peroxide reserved for special bursts of speed in attacking and escaping. Free oxygen combines with fuel such as diesel oil to produce the steam and carbon dioxide to drive the turbine under ordinary circumstances. When high speed is desired the hydrogen peroxide is utilized as the fuel. The hydrogen peroxide breaks down to provide the heat used as the source of energy. The principal advantage of the use of hydrogen peroxide is that no exhaust bubbles reach the surface, thus adding a safety factor to the submarine's operation. The hydrogen peroxide engine, however, develops temperatures in the nature of 1200° F. so that it is highly desirable to utilize sea water as a coolant. The sea water so used tends to wash away the lubricants employed in the engine and such lubricants are discharged with the sea water. Ordinary lubricants being insoluble in sea water tend to form a wake in the form of an oil slick which rises to the surface. The presence of this slick may be detected by surface craft and the advantage obtained by the submarine through the use of the hydrogen peroxide engine is largely overcome. In addition, ordinary lubricants tend to wash off the engine parts in the presence of sea water. They also are extremely corrosive and breakdown in the presence of the steam and free oxygen employed in the engines.

Many mineral oils, compounded heavy duty oils and synthetic oils have been extensively tested in an effort to eliminate this slick type of wake while retaining the necessary high lubricity and anticorrosive characteristics required for use in the engines of the hydrogen peroxide type. The results of these tests showed that to perform as required a lubricant must be either water soluble or have a specific gravity considerably greater than that of sea water. These characteristics must be retained even after the lubricant has been subjected to the rigors of the high temperatures developed in the combustion chamber of hydrogen peroxide engines or the like.

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Of the many oils tested only the water soluble oils formed by the polymerization of alkylene oxides have been found to have characteristics which approach those found to be necessary for use under the above described conditions. These water soluble polymerized alkylene oxide oils have lubricity characteristics which compare favorably with conventional petroleum oils. They are superior to most petroleum oils with regard to viscosity index, pour point and sludge formation. However, these alkylene oxide oils have been found to give inadequate lubrication under the conditions of operation described for the hydrogen peroxide engine and have been found to be unduly corrosive when compared to hydrocarbon oils.

Attempts to improve the lubricity and anticorrosive characteristics of the polymerized alkylene oxide oils while retaining their water soluble, slick free qualities have not heretofore been successful. All previously known additives either do not improve the lubricity and anticorrosive characteristics of the alkylene oxide oils or result in the lubricants forming the highly undesirable slicks.

It is, therefore, an object of the present invention to provide a new and improved additive for use with alkylene oxide oils.

Another object is to provide a new and improved alkylene oxide lubricating compound having improved lubricity and anticorrosive characteristics.

A further object is to provide a new and improved lubricating composition which is soluble in water and will not form a slick when used under water.

A still further object is to provide an additive for improving the lubricity qualities of alkylene oxide oils while decreasing their corrosiveness.

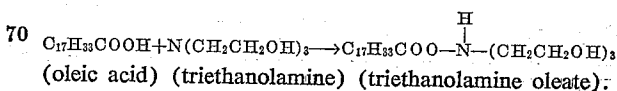
Other objects and the attendant advantages of the invention will be apparent to those skilled in the art as the invention is disclosed in the following detailed description.

The objects of the present invention are achieved by the addition to the alkylene oxide oil of a small proportion of a compound selected from a class of compounds prepared by the reaction of monoethanolamine, diethanolamine or triethanolamine with an organic acid containing from 8–20 carbon atoms. It has been found that the addition to an alkylene oxide oil of even as small a percentage of one of these compounds as 0.2 to 5.0 percent permits satisfactory lubrication of an internal combustion engine even when 50 percent of sea water is present in the crankcase of the engine. The addition of this small proportion of one of these compounds permits the use of the water soluble alkylene oxide oils as lubricants in steam cylinders and the like at high temperatures without the production of water insoluble by-products.

The additives of the present invention may be prepared by reacting monoethanolamine, diethanolamine or triethanolamine with an organic aliphatic acid containing from 8–20 carbon atoms. The aliphatic acids used for this purpose may be saturated or unsaturated, normal or forked. The acids found best for this purpose were those of higher carbon content such as oleic acid ($C_{17}H_{33}COOH$), stearic acid ($C_{17}H_{35}COOH$), palmitic acid ($C_{15}H_{31}COOH$), ricinoleic acid



The preferred additive is the compound prepared by the reaction of triethanolamine with oleic acid i.e. triethanolamine oleate.



The alkylene oxide oils used in the lubricating composition of the invention are the oils composed of the water soluble polymerized ethylene glycols and derivatives thereof. These oils are commercially available under the trade name Ucon Lubricants from the Carbide and Carbon Chemicals Company. Only the water soluble oils are useful in the composition of this invention, however. Ucon HB series lubricants are water soluble oils made by copolymerizing a mixture of ethylene oxide (C_2H_4O) and propylene oxide (C_3H_6O). These oils, being water soluble, form no slick on the surface of water. They do not carbonize in the engine as badly as petroleum oils but are depolymerized forming water soluble glycols, acids and aldehydes leaving an exceptionally clean engine. These oils may be polymerized to any desired viscosity. Of the Ucon HB series lubricants Ucon 50HB 660 is the preferred lubricant. This oil is prepared by copolymerizing a 50-50 mixture of ethylene oxide and propylene oxide. As commercially available Ucon 50HB660 has the following properties:

Viscosity SSU at:

210° F	123
100° F	660
20° F	9430
0° F	30,800
-20° F	122,400
-40° F	733,000

V.I. (ASTM D-567-41) 144

Pour point (ASTM D-97-39) ° F -55

Specific gravity at:

210° F	g./cc. 0.985
100° F	g./cc. 1.030
60° F	g./cc. 1.047

Min. flash point (ASTM-D-92033) ° F 450

Min. fire point (ASTM-D-92033) ° F 500

No particular conditions are required for the preparation of the lubricating composition. The additive is prepared by a reaction which takes place at room temperature. The amine is merely mixed with the acid with stirring. The additives may be prepared prior to mixing with the alkylene oxide oils by mixing stoichiometric quantities of the reactants or alternatively the additives may be formed in situ by mixing the reactants in the proportions recited directly in the alkylene oxide oil at room temperature.

The following example is given by way of illustration and is not to be construed as limiting the invention in any manner.

Example 1

A sample was prepared by reacting 409 gms. of triethanolamine and 387 gms. of oleic acid and diluting the resulting triethanolamine oleate with Ucon 50-HB-660 to bring the mixture up to 87.9 lbs. at EES. This is equivalent to a 2.0% solution in the Ucon 50-HB-660.

The sample was tested for the formation of an oil slick on a one cylinder, four stroke cycle, Lauson gasoline engine so modified as to give a condition of excessive oil consumption. For this purpose the oil control ring was removed from the piston leaving only the two compression rings. A mixture of hydrogen, oxygen and steam was used as the fuel. The exhaust from the engine was piped to the lowest point of a tank holding 15 gals. of seat water about four feet deep. A baffle plate with small holes was placed above the exhaust line to distribute the gases throughout the tank area.

Straight mineral oils and compounded heavy duty oils formed objectionable oil slicks on the surface of the water with the above tests. Various synthetic oils were also tested including glycerin, tricresyl phosphate, Hydrolubes, Ucon LB series, Arochlor 1273, Gulf OECA and Dow Corning Fluids No. 200, No. 710 and No. 500. All the oils tested gave unsatisfactory results except the Ucon HB series. The oils of this series did not produce a slick

and the sample of Ucon 50 HB 660 with the 2.0% of triethanolamine oleate added was tested; all the products of the exhaust were found to be soluble and left no slick on the surface.

The mixture of Ucon 50 HB 660 and triethanolamine oleate was tested for comparison with other lubricants on a wear test machine. The testing machine was a constant speed (1800 r.p.m.) motor with a hardened steel wheel attached to the shaft. This wheel was hardened to Rockwell 60c. The motor was attached to a base plate which held a lever arrangement that permitted loading of the test piece.

The test pieces were cold rolled steel $\frac{1}{2}$ " x 2" x $\frac{3}{16}$ ". The loading was accomplished by using the lever arrangement to force the test piece against the wheel. A 5:1 lever ratio gave a 20 pound loading at the point of contact. The tested lubricant was fed from a drip oiler so it just contacted the edge of the wheel as it was fed.

The test was started by allowing the oil to completely cover the sample and to flow at an arbitrary drip rate (about 90 drops per minute) which was maintained for the duration of the run. The sample was allowed to come into contact with the wheel and the test was allowed to run for 5 minutes. The test was secured by removing the sample from contact with the wheel. The resultant length of the mark on the test sample served as a comparative measurement of the quality of the lubricant tested.

A petroleum base oil SAE 30 blended with 20 percent of blown rape seed oil was used as a standard for comparison since this mixture of oils was found to permit engine operation in the presence of sea water, oxygen and steam as described above even though the lubricating qualities of the oil appeared to be marginal and it caused a bad oil slick.

For the purpose of the tests each of the oil samples tested was diluted with an equivalent amount of synthetic sea water so as to produce a lubricant containing 50 percent sea water.

The results of the water test showed that the Ucon 50 HB 660 plus 2% triethanolamine oleate mixture had better lubricating qualities than the standard petroleum base oil and showed a reduction of over 50 percent of wear over the Ucon 50 HB 660 without additive.

The Ucon 50 HB 660 triethanolamine oleate mixture was subjected to a storage test and was found not to separate out after 6 mos. at 150° F. The anticorrosive qualities of the mixture were also tested and found to be satisfactory over a period of several weeks.

From the foregoing it may be seen that there has been provided a new and useful additive for water soluble alkylene oxide lubricants which renders those oils comparable to or better than the best petroleum oils when mixed with up to 50 percent sea water. The resulting lubricant composition is soluble in sea water and remains so after being subjected to the rigors of the high temperatures of the combustion chamber of an internal combustion engine and accordingly forms no undesirable slick on the surface of the water.

This improved lubricating composition composed of copolymerized ethylene oxide and propylene oxide with up to 5% of triethanolamine oleate has been employed successfully with no corrosive results and with no slick forming effects in engines of the hydrogen peroxide type in torpedoes and submarines.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. A water soluble lubricating composition consisting essentially of a water soluble alkylene oxide oil of

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copolymerized ethylene oxide and propylene oxide, and from 0.2 to 5.0 percent by weight of triethanolamine oleate.

2. A water soluble lubricating composition consisting essentially of a water soluble alkylene oxide oil of copolymerized ethylene oxide and propylene oxide, and from 0.2 to 5.0 percent by weight of an additive selected from the group consisting of mono-, di- and triethanolamine oleate.

3. A water soluble lubricating composition consisting essentially of a water soluble alkylene oxide oil of copolymerized ethylene oxide and propylene oxide, and from 0.2 to 5.0 percent by weight of an additive selected from the group consisting of the mono-, di- and triethanolamine salts of an aliphatic acid having from 8 to 20 carbon atoms.

4. A water soluble lubricating composition consisting essentially of a water soluble polymerized alkylene oxide oil substantially half of which is ethylene oxide and half propylene oxide, and from 0.2 to 5.0 percent by weight of an additive selected from the group consisting of the

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mono-, di- and triethanolamine salts of an aliphatic acid having from 8 to 20 carbon atoms.

5. The lubricating composition of claim 4 in which the acid is oleic acid.

6. The lubricating composition of claim 4 in which the additive is triethanolamine oleate.

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