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[54] **ESTER LUBRICANTS SUITABLE FOR USE IN AQUEOUS SYSTEMS**

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[58] **Field of Search** ..... 252/49.5, 56 S, 396; 72/42

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[57] **ABSTRACT**

Ester lubricants derived from high molecular weight aliphatic dibasic acids, polyoxyalkylene glycols and monofunctional aliphatic alcohols are provided. These ester compositions are useful as lubricants and are readily emulsifiable with water. Aqueous emulsions of these esters have superior lubricating and rust inhibiting properties.

4 Claims, No Drawings

ESTER LUBRICANTS SUITABLE FOR USE IN AQUEOUS SYSTEMS

This is a division of application Ser. No. 384,674, filed Aug. 1, 1973, now U.S. Pat. No. 3,857,865.

BACKGROUND OF THE INVENTION

The use of organic esters, primarily aliphatic esters, as synthetic lubricants is well documented in the literature. These compounds are useful in the neat form in a variety of lubrication applications. They are especially important for their use in engines because of their ability to perform acceptably over a wide temperature range. Complex synthetic ester lubricants obtained from the reaction of glycols and dibasic acids with monobasic acids and alcohols are also widely used. These complex esters are generally characterized by their excellent thermal stability, oxidation-corrosion resistance and low temperature properties.

Recently the use of aqueous lubricant systems has become increasingly important. In the metalworking industry, for example, because of the high cooling requirements of many of the high-speed operations employed for the processing of metals straight mineral oil or vegetable and animal oil lubricants are no longer completely satisfactory because they do not have sufficient cooling capacity. This is particularly true in hot rolling operations. The trend has therefore been to the use of aqueous lubricant systems to overcome the cooling problem as well as reduce sludging, discoloration and other related problems. Typically, aqueous emulsions containing from about 0.1 to 25% of an emulsifiable oil are employed for this purpose.

The conventional simple and complex synthetic ester lubricants have heretofore not been adaptable for use in aqueous systems for metalworking even though they are in themselves highly efficient lubricants. They are incompatible with water and these oils do not form acceptable emulsions or dispersions without the use of highly efficient emulsifying aids.

It would be highly advantageous to have modified synthetic ester lubricants available which are readily emulsifiable with water and useful for working both ferrous and non-ferrous metals. It would be particularly useful if uniform aqueous emulsions could be formed with these modified ester lubricants without the use of external emulsifying aids by moderate agitation of the lubricant and water and if stable, i.e. did not undergo rapid phase separation, emulsions resulted. It would be even more desirable if the resulting aqueous lubricant systems had superior rust inhibiting and lubricating properties.

SUMMARY OF THE INVENTION

We have now discovered that ester compositions derived from high molecular weight dibasic acids, monofunctional alcohols and polyoxyalkylene glycols are excellent lubricants, both in the neat form and when emulsified with water. These esters form stable emulsions with water which are useful for working both ferrous and non-ferrous metals. In addition to the superior lubricating properties obtained with aqueous emulsions formed with the present esters, superior rust inhibiting properties are also obtained.

The esters of this invention are reaction products comprising about 0.05 to about 0.5 equivalent polyoxyalkylene glycol and 0.5 to 0.95 equivalent monofunctional alcohol per equivalent dibasic acid. Excellent results are obtained when the esters contain about 0.1 to 0.4 equivalent polyoxyalkylene glycol, particularly polyoxyethylene glycols, and about 0.6 to 0.9 equivalent monofunctional alcohol reacted with an equivalent dibasic acid. Additional hydroxylic or carboxylic reactants not exceeding about 0.4 equivalent can be included. The esters typically have hydroxyl values and acid values less than about 25 and preferably these values are less than 10. The polyoxyalkylene glycols used have molecular weights from about 200 to 1000. The high molecular weight dibasic acids contain from about 32 to 52 carbon atoms with dimer acids containing predominantly C_{36} dibasic acids being preferred. Useful monofunctional alcohols will contain from about 1 to about 20 carbon atoms and preferably from about 6 to 16 carbon atoms. In preparing the aqueous emulsions the concentration of the ester in water will range from 0.1 to about 25% by weight.

DETAILED DESCRIPTION

The improved synthetic ester lubricants of this invention suitable for use in aqueous systems to impart superior lubricating and rust inhibiting properties are complex ester condensation products obtained by the reaction of a polyoxyalkylene glycol, a high molecular weight dibasic acid and a monofunctional alcohol. One or more additional other compounds capable of being incorporated into the ester may be included in small amounts.

The polyoxyalkylene glycols employed have molecular weights from about 200 to about 1000 with recurring alkylene groups containing 2 to 4 carbon atoms. Polyoxyalkylene glycols satisfying the above requirements include polyethylene glycol, polypropylene glycol, polybutylene glycol, poly(ethylenepropylene) glycol and the like. Especially useful for the ester lubricants of this invention are polyethylene glycols having molecular weights from about 300 to about 800. The polyethylene glycols are available from commercial suppliers under the trade designations "Carbowax" and "Polyox" or they may be synthesized in the conventional manner. Molecular weights indicated for the polyoxyalkylene glycols are average molecular weights and it is understood that the compositions are mixtures of glycols ranging above and below the specified average molecular weight value. Polyoxyalkylene glycols having molecular weights less than about 200 or greater than about 1000 should not, however, be present in significant amounts.

The high molecular weight dibasic acids condensed with the polyoxyalkylene glycol will contain from about 30 to 60 carbon atoms. Especially useful dibasic acids are the so-called dimer acids containing from about 32 to 52 carbon atoms. The dibasic acids may be obtained by processes known to the art but, as with the dimer acids, they are usually obtained from the polymerization of monocarboxylic acids containing from about 16 to 26 carbon atoms. These unsaturated monomer acids may contain one or more sites of available unsaturation within the molecule. Dimer acids containing predominantly C_{36} dibasic acids and obtained from the dimerization of oleic acid, linoleic acid, eleostearic acid and similar singly or doubly unsaturated C_{18} monobasic acids are particularly useful for the preparation of the present lubricants. To obtain the dimer acids 2 moles of the unsaturated monocarboxylic acid are reacted,

generally in the presence of a catalytic material such as an alkaline, acid or neutral earth.

To remove ethylenic unsaturation the dimer acids may be hydrogenated. Mixtures of dimer acids derived from different sources may be employed and also trimer and tetramer acids may be present with the dimer acid. Trimer and tetramer acids are by-product acids obtained in the dimerization process and they do not adversely affect the properties of the resulting ester compositions so long as about 50% by weight of the mixture are dimer acids. In some instances the presence of these trimer and tetramer acids may even be advantageous, such as when a higher viscosity for the ester is desirable. Excellent results are obtained when the high molecular weight dibasic acid contains about 75% or more C_{36} dimer acid. Commercially available compositions sold under the trademark "Empol," which are mixtures of polymerized fatty acids having C_{36} dimer acid as the major constituent, may be advantageously employed to form the esters of this invention.

The monofunctional alcohols condensed with the polyoxyalkylene glycols and high molecular weight dibasic acid contain from 1 to about 20 carbon atoms. These alcohols have the general formula ROH where R is a hydrocarbon radical containing from 1 to about 20 carbon atoms which can be either straight-chain or branched, and if branched may contain one or more alkyl groups containing from 1 to about 4 carbon atoms, and which may be saturated or contain unsaturation. The use of mixed alcohols of the above types is not detrimental to this invention and in some instances is even advantageous. Especially useful alcohols for this invention contain from 6 to 16 carbon atoms. Illustrative of the alcohols suitable for use in the present invention to obtain improved ester products include isopropanol, butanol, t-butanol, isoamyl alcohol, n-hexanol, 2-ethylhexanol, n-octanol, isooctanol, isodecanol, capryl alcohol, lauryl alcohol, myristyl alcohol, cetyl alcohol, stearyl alcohol, tridecyl alcohol, which is mainly tetramethyl-1-nonanol, and hexadecyl alcohol which is a complex mixture of primary alcohols characterized as 2,2-dialkyl-1-ethanols where the alkyl groups are typically methyl-branched C_6 and C_8 radicals. Branched alcohols containing from about 6 to 16 carbon atoms and which are saturated or essentially so are an especially preferred embodiment of the invention.

The alcohols may be obtained from any of the conventional processes. For example, long chain linear alcohols may be obtained from natural sources or produced synthetically from ethylene using Ziegler-type reactions. Tridecyl and hexadecyl alcohols, as well as other branched chain alcohols, are obtainable from the oxo reaction, that is, by the reaction of carbon monoxide and hydrogen with a suitable olefin.

In addition to the reactants described above, namely, the high molecular weight dibasic acids, polyoxyalkylene glycols and monofunctional alcohols which are essential to obtain the improved esters of this invention useful as aqueous lubricants, small amounts of other reactants may also be included without detracting from the lubricant properties. In some instances, such additional modification may even impart enhanced physical properties and characteristics to the esters, such as increased viscosity, lubricity, oxidation and heat stability or the like. For example, small amounts of monobasic acids may be included in the preparation of the esters. Similarly, short-chain glycols and short-chain dibasic acids can be present. Such materials include, for example, glycols such as ethylene glycol, 1,3-propanediol, 1,5-pentanediol, 1,6-hexanediol, 1,9-nonanediol, 1,10-decanediol, neopentyl glycol (2,2-dimethyl-1,3-propanediol), adipic acid, sebacic acid, succinic acid, oxalic acid, glutaric acid, pimelic acid, suberic acid, azelaic acid and the like. Aromatic and cycloaliphatic diols and dicarboxylic acids may also be used. Tri- and polyfunctional materials including triols, tricarboxylic acids, polyols and polycarboxylic acids can also be used. Hydroxylic and carboxylic compounds of this type include gylcerol, sorbitol, pentaerythritol, monohydroxypivalate, trimethylolpropane, the previously mentioned trimer and tetramer acids, trimesic acid, trimellitic acid and the like. Still other materials having mixed functionality, such as alkanolamines, can be employed.

These compounds can be included in the ester preparation in small amounts to modify the physical properties of the esters. This aspect of the invention finds particular application where the resulting ester, in addition to being used as a lubricant in an aqueous emulsion, may also be used as the neat oil, thus eliminating the need for the user to keep several different lubricant ester compositions on hand for these different applications.

The reaction of the dibasic acid, polyoxyalkylene glycol, monofunctional alcohol and any other hydroxylic or carboxylic compounds which may be present is carried out using conventional esterification procedures, that is, by heating the reaction mixture with or without a catalyst at a temperature from about 100° to 300°C while removing the water of reaction. These condensation reactions are most generally conducted over the temperature range 175° to 250°C. It is not necessary that a catalyst be employed for the reaction, however, conventional acid catalysts such as sulfuric acid, alkyl and aryl sulfonic acid such as p-toluene sulfonic acid, or the like can be used to advantage. The reaction may be carried out in a diluent which is inert to the reaction conditions employed and which preferably will form an azeotrope with water to facilitate its removal. The reaction is continued until the esterification is complete or essentially so. This may readily be determined by following the decrease in acid value or hydroxyl value or by measuring the amount of water evolved.

The dibasic acid, polyoxyalkylene glycol and monofunctional alcohol may be added to the reactor as a unit charge and the reaction conducted until the acid value indicates complete or near complete reaction of the carboxyl groups or until a predetermined amount of water is recovered. When following this procedure the reactant charge should roughly correspond to the ratio of the reactants desired in the ester product. The reaction system should be essentially balanced but a slight excess of one or more of the reactants can be present. An alternative procedure, is to react the dibasic acid and the polyoxyalkylene glycol and when this reaction is complete, or essentially so, to charge the monofunctional alcohol and to complete the reaction. Still another method for preparing the esters would be to react the dibasic acid and monofunctional alcohol and when this esterification is complete to add the polyoxyalkylene glycol and complete the reaction. In this latter instance an excess of the monofunctional alcohol may be initially reacted, in fact, the dibasic acid may be completely reacted with monofunctional alcohol so that no

free carboxyl groups remain. The polyoxyalkylene glycol may be added and a transesterification reaction undertaken to displace the appropriate amount of monofunctional alcohol. The higher boiling polyoxalkylene glycols readily displace the monofunctional alcohols using suitable transesterification conditions and the resulting products are comparable in all respects to those obtained using conventional unit charge or step-wise esterification procedures. The common esterification and transesterification catalysts can be used.

An alternative but less desirable procedure for the preparation of the ester lubricants of this invention would be to react the dimer and monofunctional alcohol in the presence of ethylene oxide, in other words, the polyoxyalkylene glycol would be prepared in situ. Suitable catalysts and/or diluents could be added. For maximum control of the reaction and of the products obtained it is preferred that the polyoxyalkylene glycol be prepared prior to reaction with the monofunctional alcohol and high molecular weight dibasic acid.

It is evident that considerable variation is possible in the preparation of the esters of this invention, however, to obtain acceptable emulsifiability and lubrication it is necessary to maintain a balance between the high molecular weight dibasic acid and polyoxyalkylene glycol. The esters should contain at least about 2% by weight reacted polyoxyalkylene in order to obtain acceptable emulsification with water, however, the amount of polyoxyalkylene glycol reacted should not exceed about 40% by weight since above this level the lubrication properties and the rust properties begin to decrease. For best results the esters should contain about 5 to about 30 weight percent reacted polyoxyalkylene glycol.

The esters of this invention have acid values and hydroxyl values less than 25 and preferably the acid values and hydroxyl values are less than 10. It is evident, therefore, that while the ester compositions need not be balanced with regard to stoichiometry best results are observed when a balanced or essentially balanced ester is obtained. The reactant charge can be varied, of course, depending on the particular method used to prepare the ester as discussed above. In general, however, the polyoxyalkylene glycol will range from about 0.05 to about 0.5 equivalent per equivalent of high molecular weight dibasic acid and, more preferably, will range from about 0.1 to 0.4. The monofunctional alcohol will range from about 0.5 to 0.95 equivalent per equivalent dibasic acid, however, best results are obtained with 0.6 to 0.9 equivalent monofunctional alcohol per equivalent dibasic acid. If other hydroxylic reactants are included in the ester preparation the amount of polyoxyalkylene glycol and/or monofunctional alcohol will be reduced accordingly. If a second carboxylic compound is included in the reaction the amount of dibasic acid will be reduced accordingly. In general the amount of additional reactants, either hydroxylic or carboxylic, will not exceed 0.4 equivalent and preferably will be less than about 0.25 equivalent.

The ester lubricants of the instant invention find particular utility in metalworking operations where a high degree of cooling by the lubricant is required. The esters are preferably used as aqueous emulsions where the concentration of the ester in water ranges from about 0.1 to about 25 percent by weight and, more preferably, from about 1 to about 10% by weight. The resulting aqueous lubricant formulations may be added to the metalworking elements, such as the working rolls, or may be applied to the metal itself by spraying or immersion of the metal sheet in a suitable bath. These esters applied in the form of aqueous emulsions form a uniform continuous lubricant film between the working rolls and the metal to provide efficient lubrication. In addition they have a high degree of cooling capacity. The lubricant emulsions are useful for the working of both ferrous and nonferrous metals. They may be formulated with other additives such as stabilizers, corrosion inhibitors and the like. The lubricant emulsions may be conveniently recycled for reuse with the result that considerable economic advantage can be realized. Makeup water may be required to bring the ester to the original concentration. It may also be desirable upon recycling to strain or filter the residue in order to remove metal scale or other particles picked up during the processing operation. This is particularly true where the aqueous lubricant emulsions are applied by the use of spray nozzles.

The present esters are readily emulsifiable with water in the proportions indicated above and do not require the use of additional external emulsifying aids to obtain a stable emulsion. The emulsions are readily formed using simple agitation and, once formed, the emulsions do not undergo rapid phase separation but remain emulsified for long periods. In certain instances where extremely stable emulsions are desired, it may be advantageous to add a small amount of one or more other external emulsifying aids commonly employed for this purpose, however, this is not necessary to get a good emulsion.

In addition to use in the emulsified state, the present esters can also be used in the neat form, that is, the straight oil can be utilized as a lubricant. The modification of these esters with polyoxyalkylene glycol does not significantly impair the lubricating effectiveness of the esters. When used in the neat form the oil may be blended with other synthetic ester lubricants, mineral oils or the like and combined with additives to achieve the desired formulation.

The following examples directed to the preparation of the esters described above and their utilization as lubricants illustrate the invention more fully, however, the examples are not intended to limit the scope of the invention. All parts and percentages in the examples are given on a weight basis unless otherwise indicated.

EXAMPLE I

To a glass reactor equipped with a stirrer, thermometer and water trap fitted to a condenser were charged 212.8 gms hexadecyl alcohol (a commercially available complex mixture of primary alcohols characterized as 2,2-dialkyl-1-ethanols where the alkyl groups are typically methyl-branched), 35.2 gms polyoxyethylene glycol having an average molecular weight of about 400 and 252 gms dimer acid (a commercially available polymerized acid sold under the name Empol 1018 and consisting of about 83% C_{36} dibasic acid and 17% C_{54} tribasic acid). A slight excess of the hexadecyl alcohol was employed based on the calculated equivalents charge ratio of 0.8:0.2:1.0 (hexadecyl alcohol:polyoxyethylene glycol:dimer). The reaction mixture was heated at 220°C under a nitrogen atmosphere for about 12 hours until the acid value had decreased to about 3.8 and 15.7 mls water were taken off. Acid values are determined in accordance with A.O.C.S. Test Method

Te 1a–64–T. The mixture was then heated to about 250°C under vacuum for about 1 hour to strip off the excess hexadecyl alcohol. 42.5 Grams hexadecyl alcohol were removed. The resulting lubricant ester had an acid value of 3.1 and hydroxyl value of 5.6.

A portion (20 mls) of the ester was poured into 100 mls of cold tap water while stirring with a glass rod. The ester immediately emulsified. This emulsion was stable and showed no signs of phase separation after standing 24 hours at room temperature. Even after 72 hours the emulsion was not completely broken and was readily reformed with minimal agitation.

A 1% aqueous emulsion was prepared and used to determine the rust resistance of the aqueous lubricants. The test is conducted by placing a filter paper into a petri dish and lightly sprinkling cast iron filings over the paper. The aqueous emulsion is then poured over the filings to wet the paper and cover about one-half the filings. The dish is covered, allowed to stand undisturbed and the amount of discoloration (rust formation) observed at 15 minute intervals. If after 2 hours there is no discoloration or only a trace of discoloring the aqueous emulsion is considered to have good resistance to rust formation. The rust resistance of the 1% aqueous emulsion prepared with the above ester was rated good even under these severe test conditions.

To demonstrate the effectiveness of esters of this invention as lubricants, both as aqueous emulsions and in the neat form, they were evaluated using a Falex machine. This machine provides a convenient and reliable means of determining the film strength or load-carrying capacity of lubricants as extreme pressures are applied. Falex testing is recognized throughout the industry as a means of measuring the relative effectiveness of various lubricants. The Falex wear test (ASTM D 2670–67) utilized 60 gm sample of the ester lubricant or 5% aqueous emulsion thereof. The loading device is attached and the cup containing the sample positioned so that the steel pin and blocks are completely immersed in the test sample. The load is then increased to 350 pounds and run for 5 minutes. After this time the load is further increased to 1000 pounds and maintained for 30 minutes. The difference between the readings taken at the beginning and end of the 30 minutes indicates the amount of wear. Each unit represents 0.0000556 inches of wear. The lower the wear number the better the material is considered as a lubricant. When dealing with 5% aqueous emulsions, wear values less than 25 are considered good and numbers less than 15 are rated excellent. A 5% aqueous emulsion of the above ester gave only 9 units of wear which is excellent.

To further demonstrate the ability of these aqueous emulsions to function as lubricants under extreme pressures, additional testing was conducted with the Falex machine. After satisfactory completion of the testing at 1000 pounds for 30 minutes the load is increased by 250 pounds and run for one minute at the increased load. If the metal pin does not fail this procedure is continued until failure. Upon failure, the last load reading prior to the failure is reported. The aqueous lubricant prepared with the present ester satisfactorily withstood a loading of 2759 pounds before failure.

EXAMPLE II

Employing equipment and chemicals similar to that described in Example I, except that isooctyl alcohol was substituted for hexadecyl alcohol a lubricant ester was prepared. 351 Grams dimer acid and 49 gms polyoxyethylene glycol were first reacted with stirring between about 200°C and 210°C for about 2 ½ hours until the acid value was 136 and 3.5 mls water was collected. The reaction mixture was then cooled and 159.7 gms isooctyl alcohol charged. The reactor and its contents were then heated at about 220°C for about 7 ½ hours. After this time the acid value of the reaction mixture was 5.2. A vacuum was applied to the system for about 1 hour to remove unreacted isooctyl alcohol. The resulting ester product, which based on the amount of unreacted isooctyl alcohol recovered, contained 0.2 equivalent of PEG 400 and 0.8 equivalent isooctyl alcohol reacted per equivalent of dimer acid, had an acid value of 5.2 and a hydroxyl value of 9.2. The ester had a flashpoint of 595°F and firepoint of 640°F as determined using ASTM test procedure D 92–66. Viscosities (ASTM D 445–65) at 100°F and 210°F were 181 and 21.4 centistokes, respectively. The ester formed stable emulsions very readily without the aid of external emulsifying aids. A 1% aqueous emulsion of the ester tested in accordance with the rust test previously described showed good resistance to rust formation. The Falex test on a 5% emulsion showed 25 and reached 2250 pounds before failure. Significant improvement of the performance properties of these aqueous emulsions is possible by the addition of suitable additives such as EP agents, antifoam agents, bacteriostats, etc. and the emulsions give good response to the addition of these materials.

EXAMPLE III

To demonstrate the versatility of the present invention a lubricant ester was prepared by reacting 1 equivalent dimer acid, 0.2 equivalent polyoxyethylene glycol, 0.3 equivalent neopentyl glycol and 0.5 equivalent 2-ethylhexanol. The reactants were added as a unit charge, heated initially at 180°C and then at 220°C until the near theoretical amount of water was evolved. A vacuum was pulled on the system for one-half hour at 220°C to remove the slight excess of 2-ethylhexanol which was present and unreacted. The reaction mixture was cooled and filtered after the addition of a diatomacious earth filtering aid. The ester product had an acid value of 5.5, a flashpoint of 615°F and firepoint of 665°F. The viscosities of the ester at 100°F and 210°F were 376 and 37.4, respectively. The ester emulsified readily and a 5% emulsion showed only 8 units wear in the Falex test. This is even more surprising considering that the undiluted ester gave 116 units wear in the same test.

EXAMPLE IV

Following the procedure described in Example II, except that the monobasic alcohol was butanol, an ester was prepared utilizing 1 equivalent dimer acid, 0.2 equivalent PEG 400 and 0.8 equivalent butanol. The final ester product had an acid value of 6.2, a hydroxyl value of 5.3, with flash- and firepoints of 580°F and 640°F, respectively. Stable emulsions were obtained with the ester and a 1% aqueous emulsion was rated good in the rust test. Falex wear with a 5% aqueous emulsion gave only 20 units wear.

EXAMPLE V

Using a similar procedure and the reactants described in Example IV, except that the polyoxyethylene

glycol had an average molecular weight of 600, a useful lubricant ester composition was similarly obtained. Stable emulsions were readily prepared with the ester and these emulsions gave good results when evaluated in the rust test and Falex wear test.

EXAMPLES VI and VII

Employing a preparative technique similar to that described in Example II, esters having the following equivalents ratios were prepared:

	EXAMPLES	
	VI	VII
Dimer Acid	1.0 eq.	1.0 eq.
PEG 400	0.1 eq.	0.4 eq.
2-Ethylhexanol	0.9 eq.	0.6 eq.

Ester VI was reacted to an acid value of 2.3 while the lubricant ester VII had an acid value of 4.3. Both esters were readily emulsifiable with water with moderate agitation and the emulsions were homogenous and did not undergo rapid phase separation. One percent aqueous emulsions of both of these esters had good ratings in the rust test. A 5% aqueous emulsion of the ester of Example VI showed 25 units of wear in the Falex test while the emulsion prepared with the ester of Example VII gave 22 units of wear.

The superior and unexpected results obtained with the synthetic esters of the present invention are evident from the following demonstration wherein an ester was similarly prepared except that the PEG 400 was not included in the reaction. The ester was the reaction product of 1 equivalent dimer acid with 1 equivalent 2-ethylhexanol and had an acid value of 2.5 and a hydroxyl value of 0.7. This ester was not emulsifiable with either hot or cold water even with vigorous agitation. To obtain an emulsion with this ester required the use of 20 wt. % of an external emulsifying aid (Igepal 630—a commercially available ethoxylated nonyl phenol) and even then the emulsion was not stable. An emulsion containing 5% of this ester gave 140 units of wear in the Falex test. Also these emulsions had poor rust prevention properties.

EXAMPLES VIII – X

Esters having an equivalent ratio of 1.0:0.2:0.8 (dimer acid: PEG 400:monobasic alcohol) were prepared. Various commercially available mixed straight-chain alcohols manufactured by the oxo process were used in these examples. For ester VIII a mixture of C_{10} and C_{12} alcohols was used while for preparation IX mixed C_{12} and C_{14} alcohols were employed. A mixture of linear alcohols containing 16 to 20 carbon atoms was used in Example X. The table below sets forth the acid value and hydroxyl value obtained for the resulting esters and the results obtained in the Falex wear test and rust test with emulsions prepared with these esters:

	EXAMPLES		
	VIII	IX	X
Acid Value	2.2	2.2	2.3
Hydroxyl Value	8.5	6.2	7.6
Rust Test Results	Good	Good	Good
Units Wear In Falex Test	20	11	10

The emulsions obtained with the above esters were all homogeneous and had good stability.

EXAMPLE XI

An ester comprising the reaction product of 1 equivalent C_{36} dibasic acid, 0.2 equivalent polyoxyethylene glycol having an average molecular weight of 400 and 0.8 equivalent tridecyl alcohol, consisting mainly of tetramethyl-1-nonanols, was prepared using a procedure similar to that described in Example II. The resulting lubricant ester was readily emulsifiable in water in all proportions and the emulsions so prepared had excellent stability and showed good rust resistance when placed in contact with cast iron filings. A 5% aqueous emulsion of the ester gave only 11 units wear after 30 minutes testing at 1000 pounds and withstood 3250 pounds pressure before failure.

EXAMPLE XII

To further demonstrate the advantage of the present invention an ester was prepared by reacting 1 equivalent of the dimer acid with 2 equivalents polyoxyethylene glycol (400 average molecular weight) at 200°C to 220°C until the acid value reached 5.05. There were insoluble materials present when it was attempted to emulsify this ester with cold water. The ester could be emulsified in hot water but after only one-half hour the emulsion was essentially completely separated. An emulsion containing 5% by weight of the ester gave 139 units of wear in the Falex test.

We claim:

1. An aqueous lubricant composition suitable for metalworking and having improved rust protection properties containing about 0.1 to about 25 percent by weight of an ester comprising the condensation product of 0.05 to about 0.5 equivalent polyoxyalkylene glycol having a molecular weight from about 200 to about 1000 and having repeating alkylene units containing from 2 to 4 carbon atoms, 0.5 to 0.95 equivalent monofunctional alcohol of the formula ROH where R is an aliphatic hydrocarbon radical containing from 1 to about 20 carbon atoms and 1.0 equivalent of an aliphatic dibasic acid containing from about 30 to 60 carbon atoms, said ester having an acid value less than 25, a hydroxyl value less than 25 and containing about 2 to about 40 percent by weight polyoxyalkylene glycol.

2. The aqueous lubricant composition of claim **1** wherein the polyoxyalkylene glycol is a polyethylene glycol having a molecular weight from about 300 to about 800, the monofunctional alcohol contains from about 6 to 16 carbon atoms and the dibasic acid is a dimer acid containing from about 32 to 52 carbon atoms.

3. The aqueous lubricant composition of claim **2** wherein 0.1 to 0.4 equivalent polyethylene glycol and 0.6 to 0.9 equivalent monofunctional alcohol are reacted per equivalent dimer acid, the ester contains from about 5 to about 30 weight percent polyethylene glycol and has an acid value less than 10 and a hydroxyl value less than 10.

4. The aqueous lubricant composition of claim **3** containing from about 1 to about 10 weight percent of an ester derived from a dibasic acid containing 75% or more C_{36} dimer acid, a polyethylene glycol having a molecular weight of about 400 and 2-ethylhexanol.

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