

Description

A functional fluid is a term which encompasses a variety of fluids including but not limited to tractor fluids, automatic transmission fluids, manual transmission fluids, hydraulic fluids, power steering fluids, fluids related to power train components and fluids which have the ability to act in various different capacities. It should be noted that within each of these fluids such as, for example, automatic transmission fluids, there are a variety of different types of fluids due to the various transmissions having different designs which have led to the need for fluids of markedly different functional characteristics. One type of functional fluid is generally known as a tractor fluid which can be used in connection with various types of tractor equipment in order to provide for the operation of the transmission, gears, bearings, hydraulics, power steering, mechanical power take off and oil immersed brakes of the tractor.

The components included within a functional fluid such as a tractor fluid must be carefully chosen so that the final resulting fluid composition will provide all the necessary characteristics required and pass a variety of different types of tests. In general a tractor fluid must act as a lubricant, a power transfer means and a heat transfer means.

Tractor fluids have a number of important specific characteristics which provide for their ability to operate within tractor equipment. Such characteristics include the ability to provide proper frictional properties for preventing wet brake chatter of oil immersed brakes while simultaneously providing the ability to actuate wet brakes and provide power take-off (PTO) clutch performance. A tractor fluid must provide sufficient antiwear and extreme pressure properties as well as water tolerance/filterability capabilities.

The extreme pressure (EP) properties of tractor fluids are demonstrated by the ability of the fluid to pass a spiral bevel test as well as a straight spur gear test. The tractor fluid must pass wet brake chatter tests as well as provide adequate wet brake capacity when used in oil immersed disk brakes which are comprised of a bronze, graphitic compositions and asbestos. The tractor fluid must demonstrate its ability to provide friction retention for power shift transmission clutches such as those clutches which include graphitic and bronze clutches.

U.S. Patent 4,410,438 discloses a lubricant and liquid fuel composition which includes borated epoxides which are indicated as being useful in fluids such as heat exchange fluids, transmission fluids, and hydraulic fluids.

U.S. Patent 3,933,659 discloses a functional fluid for lubricating oil compositions which is com-

prised of a major amount of an oil of lubricating viscosity and an effective amount of an additive. The additive includes effective amounts of an alkaline succinimide, a group II metal salt of a dihydrocarbyldithiophosphoric acid, a basic sulfurized alkaline earth metal alkyl phenate and a component which is a fatty acid ester, fatty acid amide or fatty acid amine or mixtures thereof. The patent indicates that the lubricating compositions are useful as functional fluids in systems requiring fluid coupling, hydraulic fluid and/or lubrication of relatively moving parts. The lubricating compositions are indicated as being useful as the functional fluid in automatic transmissions and particularly in the automatic transmissions of passenger automobiles.

U.S. Patent 4,116,877 discloses an elastomer compatible seal swell additive. The additive may be used in connection with automatic transmission, power transmission fluids and hydraulic steering fluids. The fluid is a mineral lubricating base oil which includes an oil-soluble bis(hydrocarbyl) phosphite ester and an oil-soluble hydrocarbyl substituted phenol wherein a specific weight ratio is maintained with respect to the phosphite and phenol. The patent indicates that the inclusion of these particular additive compounds in the particularly disclosed ratio provides enhanced elastomer compatibility to the fluid.

Published European Patent Application 113,199 published July 11, 1984, discloses a tractor hydraulic fluid which includes oleyl phosphite in a tractor antifriction hydraulic fluid as well as thioethyloctadecenylsuccinate containing tractor hydraulic fluids.

British Patent 1,452,513 dated October 13, 1976, discloses lubricant compositions which include a fatty acid and a fatty acid amide in a wet braking system for tractors which was found to be useful in reducing the amount of noise over a wide temperature range.

British Patent 1,440,261 discloses a composition for reducing the noise in the wet braking systems of tractors. The fluid was comprised of a lubricant oil, and a detergent or dispersant mixed with stearic acid. The composition indicated that it also included alkylene polyamine dispersants, calcium and barium sulfonates and phenates, antiwear-antioxidants and oleic acid.

In accordance with the invention there is provided a functional fluid comprising:

a major amount of up to 99.5 percent by weight of a hydrocarbon oil and a minor amount, sufficient to improve characteristics of the fluid, of an additive comprising:

a calcium salt present in an amount of from 0.5 percent to 5.5 percent by weight;

an extreme pressure/antiwear agent in the form

of a zinc dithiophosphate present in an amount of 1 percent to 4 percent by weight;

a borated epoxide present in an amount of 0.1 percent to 1.5 percent by weight; and

a carboxylic solubilizer present in an amount of 0.1 percent to 1 percent by weight in the form of a reaction product of polybutenyl succinic anhydride with N,N-diethylethanolamine at a molar ratio of about 1:2;

wherein the percentages are all based on the weight of fluid.

A functional fluid, especially in the form of a tractor fluid, is described herein which comprises a major amount of a hydrocarbon oil and a minor amount, sufficient to improve characteristics (e.g.) lubricant ability, power transfer means ability, and heat transfer means ability) of the fluid of an additive. The additive includes four essential ingredients which are each present in an amount sufficient to improve characteristics as indicated above and may include other components to enhance these characteristics or to provide even further desirable characteristics to the fluid. The additive necessarily includes a calcium salt, an EP/antiwear agent in the form of a zinc dithiophosphate salt, a borated epoxide and a carboxylic solubilizer in the form of a reaction product of a polybutenyl succinic anhydride with N,N-diethylethanolamine at a molar ratio of about 1:2. Preferred amounts and ranges with respect to the additive and the four essential components are described below. However, since the additive may be used in a number of different types of fluids, these preferred amounts might vary and might also vary somewhat due to other components and their amounts.

The inventors have found that although there is some flexibility with respect to the amounts of each of these four essential components which must be present and the precise definition of each of these four components as generically described above, a useful functional fluid cannot be obtained if the amount limitations are completely ignored or if other components are randomly substituted for these four essential ingredients.

In accordance with the invention, we have found it possible: to provide a functional fluid possessing a wide variety of different functional characteristics especially when used as a tractor fluid;

to provide a functional fluid capable of passing a wide variety of different tests with respect to characteristics such as EP/antiwear characteristics, water tolerance, brake capacity and chatter and filterability;

to simultaneously provide improved performance in the areas of improved low temperature fluidity/filterability, EP/antiwear performance, friction improving properties, wet brake chatter suppression, and capacity with respect to actuating hy-

draulics, transmissions, power steering and braking without harming performance in other areas;

to increase performance with respect to EP/antiwear performance without having an undesirable effect on corrosion testing and transmission performance;

to provide improved water tolerance by including surfactants while not limiting EP performance;

to provide a functional fluid capable of passing a wide variety of different tests with respect to characteristics such as frictional characteristics, low temperature fluidity, seal swell characteristics, antifoaming characteristics, antioxidation characteristics and EP protection as demonstrated by spiral bevel and straight spur gear testing;

to provide a sufficient power steering performance while simultaneously providing sufficient transmission performance as demonstrated in Turbo Hydra-matic oxidation testing (a General Motor Corp. test);

to provide a fluid which provides sufficient friction retention for power shift transmission clutches and provides corrosion inhibition particularly with respect to yellow metal (i.e. copper, brass, bronze) corrosion while simultaneously providing improved EP performance, proper frictional properties for wet brake chatter suppression and simultaneously providing wet brake capacity and power take/off clutch performance; and

to provide a functional fluid which includes its essential components such that the fluid simultaneously provides a variety of desirable characteristics.

Various preferred features and embodiments of the present invention will now be described by way of non-limiting examples.

The present invention may be produced and sold in the form of a functional fluid final product which can be included in various mechanical devices such as tractors. However, the invention is generally produced in the form of a concentrate which is then substantially diluted within a hydrocarbon oil to form the final fluid. The concentrate itself is made up of various components which are themselves often contained within an oil of some type, i.e., a diluent or "dil" oil. This should be kept in mind with respect to the percentage parts by weight of the components present within the functional fluid. The parts by weight mentioned with respect to the amount of each of the components present within the functional fluid is the parts by weight of the active chemical, and not that component as it might be added in combination with its "dil" oil.

The four essential components of the present functional fluid are: (1) calcium salt; (2) antiwear agent in the form of a zinc dithiophosphate salt;

(3) borated epoxide; (4) carboxylic solubilizer. Each of these four components as well as other components which are preferably present in the functional fluid of the invention will now be described in detail. It should be pointed out that none of these components themselves are per se novel compounds. However, the presence of these compounds in combination with each other does provide a novel functional fluid which provides improved characteristics not before obtainable.

A variety of different types of metal salts have been disclosed and have been indicated as being especially valuable due to their detergent or dispersant properties and their ability to neutralize undesirable acid bodies formed in lubricants during the operation of the engine or device in which the lubricant is included. Such metal salts are generally in the form of overbased and/or neutral complexes with high molecular weight aliphatic carboxylic acids, sulfonic acids, anhydrides, esters, amides, imides or salts. These overbased complexes may be used as additives in lubricating oils, gasoline or other organic materials.

Overbased complexes in general are disclosed within U.S. Patent 3,714,042 which discloses for purposes of disclosing calcium salts and calcium salt complexes which might be used in connection with the present invention. The present inventors have found that although numerous other types of metal salts and metal salt complexes are generally used in the art, only calcium salts and calcium salt complexes provide the desirable characteristics of the functional fluid of the present invention. Further, it has now been found that it is preferable to include overbased and/or neutral calcium complexes in the form of overbased and/or neutral calcium sulfonates, overbased and/or neutral calcium sulfonate-carboxylates and overbased calcium carboxylates.

A mixture of overbased carbonated calcium complexes useful in connection with the functional fluid of the present invention can be formed by carbonating an oil soluble sulfonic acid (e.g. sulfonic acids of the type comprising petroleum sulfonates, sulfonated alkyl benzenes, etc.) alone or in combination with a calcium alkyl phenate, a mixture of lower alcohols and an excess of lime. The oil soluble sulfonic acid or mixture of acids and calcium alkyl phenate are overbased by the use of the lime. At this point an overbased carbonated calcium complex has been formed. Such a complex can be used in connection with the present invention. However, it might be desirable to take the solution which has been overbased with lime and then stabilize it by post treating the complex with a polyisobutene substituted succinic anhydride. The overbased calcium complex used in connection with the present invention may be used in com-

bination with other similar compounds, e.g., including calcium sulfonates which are combined with calcium phenates. This component of the invention is likely to contain a mixture of neutral and overbased salt complexes.

The use of the term "complex" refers to basic metal salts which contain metal in an amount in excess of that present in a neutral or normal metal salt. The "metal ratio" characterizing a complex is thus the ratio of the total equivalents of metal to the equivalents of metal in the form of neutral or normal metal. The "base number" of the complex is the number of milligrams of KOH to which one gram of the complex is equivalent as measured by titration.

The "base number" of the calcium complexes used in connection with the present invention varies over a range of from about 0 to about 500 TBN. As such complex is present within a diluent oil, the base number of the calcium complex is preferably in the range of from about 200 to about 400 and more preferably about 300.

In the present invention, the metal salt complex must include some calcium metal salt complex. However, there may also be present other metal salt complexes and there may be present calcium salts which are not "overbased."

A useful calcium complex for use in connection with the present invention could be prepared by the following procedure:

To 950 grams of a solution of a basic, carbonated calcium salt of an alkylated benzene sulfonic acid (average molecular weight 385) in mineral oil (base number about 300, calcium -- 12.0 percent and sulfur -- 1.4 percent) there is added 50 grams polyisobutene (molecular weight 1000) -- substituted succinic anhydride post treatment (having a saponification number of 100) at 25°C. Mixture is stirred for 0.65 hours at 55°C -- 57°C and then at 152°C -- 153°C for 0.5 hours and filtered at 150°C. The filtrate has a base number of about 300 and contains 53 percent of mineral oil.

The calcium salts complexes preferably used in connection with the present invention are useful in providing improved characteristics in areas such as dispersancy and antirust and as used in a tractor fluid is present in an amount of about 0.5 to about 5.5 parts by weight based on the weight of the fluid.

The EP/antiwear agent used in connection with the present invention is in the form of a zinc dithiophosphate. Although there are an extremely large number of different types of antiwear agents which might be utilized in connection with such functional fluids, the present inventors have found that zinc dithiophosphate type antiwear agents work particularly well in connection with the other components to obtain the desired characteristics.

Particularly useful zinc dithiophosphate antiwear agents are disclosed within U.S. Patent 4,263,150 which discloses preferred zinc dithiophosphates.

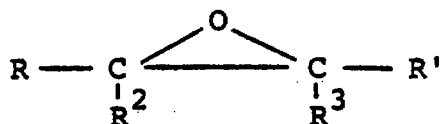
It has been found that salts of dialkylphosphorodithioic acids which are treated with phosphites and/or olefins work particularly well in connection with the present invention. More specifically, treating such salts or their acid precursors with a triaryl phosphite, and specifically, triphenyl phosphite, provide results which work particularly well in connection with the functional fluid and particularly the tractor fluid of the present invention. By treating these zinc salts or their acid precursors with triaryl phosphite compounds, the treated zinc salts have a reduced tendency to stain and corrode the metal parts that they are used in connection with. Specifically, such treated zinc salts or acid precursors are much less likely to stain or corrode copper parts.

The salts of dialkylphosphorodithioic acids are known to be useful with respect to their antiwear properties as used within lubricating compositions. However, the antiwear agents used in connection with the present invention have removed the sulfur activity of such zinc salts by some means. One means for removing the sulfur activity involves treating the salt or their acid precursors with phosphites. For example, an antiwear agent useful in connection with the present invention can be prepared by the following method:

Triphenylphosphite is heated with a zinc dialkylphosphorodithioate or a mixed zinc salt of a dialkylphosphorodithioic acid and a carboxylic acid. The dialkylphosphorodithioic acid used in the preparation of the zinc salt is itself prepared by the reaction of at least one alcohol with phosphorus pentasulfide which contains a stoichiometric excess of sulfur.

The zinc dithiophosphate component of the present invention is added in an amount sufficient to improve antiwear properties of the fluid and as used in a tractor fluid is present in an amount of about 1 percent to about 4 percent by weight based on the weight of the fluid.

Various boron containing compounds are known to be useful in connection with functional fluids. It has now been found that borated epoxides work particularly well in combination with the other components described herein to provide a functional fluid with improved characteristics. Such borated epoxides are obtained by reacting an epoxide of the general structural formula:



wherein R, R', R² and R³ are hydrogen or a C₈₋₃₀ Hydrocarbonyl group, at least one of which is hydrocarbonyl, with boric acid, boric oxide or an alkyl borate of the formula (RO)_xB(OH)_y wherein x is 1 to 3 and y is 0 to 2, there sum being 3, or boric oxide and R is an alkyl group containing 1 to 6 carbon atoms. Such borated epoxide compounds are disclosed within U.S. Patent 4,410,438.

One preferred borated epoxide is obtained as the result of reacting boric acid with a 1,2-epoxide mixture with the epoxide containing about 16 carbon atoms.

It is possible to prepare a borated epoxide useful in connection with the present invention by including 1,2-epoxide hexadecane in combination with boric acid. The mixture is heated to about 180°C in the presence of water and toluene. The reaction may be carried out in the presence of a diluent oil. The resulting product is a borated epoxide compound which is useful in connection with the functional fluid of the present invention.

The borated epoxide is present in an amount sufficient to provide the fluid with an ability to pass fluid related tests and for a tractor fluid is present in an amount of about 0.1 percent to about 1.5 percent by weight based on the weight of the fluid.

The fourth essential component of the present functional fluid is a carboxylic solubilizer. This component is capable of interacting with other components in such a manner so as to provide a microemulsion of water particles so as to provide improved water tolerance and filterability. The carboxylic solubilizer component is present in sufficient amount so as to provide these characteristics, i.e., improved water tolerance and filterability, and for a tractor fluid is about 0.1 percent to about 1 percent by weight based on the weight of the fluid. Preferred examples of such carboxylic solubilizers are disclosed within U.S. Patent 4,435,297.

The carboxylic solubilizers used in connection with the present functional fluid are nitrogen-containing phosphorus-free carboxylic acid derivatives. These derivatives are made by reacting an acylating agent with an alkanol tertiary monoamine. It has now been found that particular solubilizing agents work particularly well in connection with functional fluids and especially those functional fluids useful as tractor fluids. The carboxylic solubilizer used in the present invention is the product of a reaction of polybutylene succinic anhydride with N,N-diethylethanolamine at a molar ratio of 1:2. The resulting product is predominantly an ester-salt and contains a small amount of diester. Further, the product may contain small amounts of free unreacted polybutylene and trace amounts of maleic anhydride reacted with N,N-diethylethanolamine.

The carboxylic solubilizer is preferably obtained by the reaction at a temperature in the range of about 30°C to the decomposition temperature of one or more of the reacting components of (A) the carboxylic acid acylating agent with (B) the alkanol tertiary monoamine.

In addition to the four essential components described above, the present functional fluid preferably includes a viscosity improving agent and an antifoaming agent. The type and amount of each component is adjusted depending on factors such as the temperature of operation, the desired viscosity and amount of agitation the fluid is subjected to and the amount of foaming permitted. Since a functional fluid is likely to be utilized in equipment over a wide temperature range, the inclusion of the viscosity improving agent in order to aid in the regulation of the viscosity of the fluid is highly desirable. The viscosity improver is generally present in an amount of about 0.5 to about 8 percent by weight based on the weight of the fluid. Further, since the fluid is generally subjected to substantial mechanical agitation and pressure, the inclusion of an antifoaming agent is highly desirable in order to reduce and/or eliminate foaming which could create problems with the mechanical operation of the device the fluid is used in connection with. The antifoaming agent is generally present in an amount of about 0.005 to about 0.08 parts by weight based on the weight of the fluid.

Some useful viscosity index improvers include well-known polymethacrylate compounds, hydrogenated styrene-butadiene viscosity improvers and styrene-maleic copolymers. A useful antifoaming agent includes a combination of about 90 percent by weight of kerosene and about 10 percent by weight of a silicone agent (DC 200, VIS 30,000 cSt at 25°C).

The functional fluid of the present invention can be in the form of various specific types of functional fluids such as hydraulic/transmission fluids, brake fluids, power steering fluids and tractor fluids, the precise composition of which might vary slightly. The precise composition of such fluids can be formulated by those skilled in the art upon reading the present disclosure and considering the characteristics of the fluid which are effected by the components and the amount ranges disclosed. In order to provide the present invention in the form of a final product it is necessary to include the four essential components within a hydrocarbon oil. Preferably the four essential components in the form of active chemicals are present within the hydrocarbon oil in an amount in the range of about 0.5 percent to about 19.5 percent by weight based on the total weight of the functional fluid of the invention. Accordingly, the hydrocarbon oil is present in the amount in the range of about 81.5

percent to about 99.5 percent based on the total weight of the functional fluid.

The four essential components of the present invention could be included by themselves or in combination with other components within a concentrate. The concentrate could contain from about 1 percent to about 99 weight percent of the active chemical with the remainder of the concentrate comprising a hydrocarbon oil.

When formulating a tractor fluid the hydrocarbon oil is generally present in an amount in the range of about 81.5 weight percent to about 99.5 weight percent. The individual essential components of the tractor fluid are present in the following amounts: the calcium salt is present in an amount of about 0.5 weight percent to about 5.5 weight percent; the EP/antiwear agent is present in an amount of about 1 percent to about 4 weight percent; the borated epoxide is present in amount of about 0.1 percent to about 1.5 weight percent and the carboxylic solubilizer is present in the amount of about 0.1 percent to about 1 weight percent, with all of the amounts being based on parts by weight of the active chemical in the tractor fluid as a whole.

In a particularly preferred embodiment of the present invention the calcium salt is present in an amount of about 1.41 weight percent or about 3 percent with its diluent oil. The EP/antiwear agent is present in an amount of about 1.7 weight percent; the borated epoxide is present in an amount of about 0.5 weight percent and the carboxylic solubilizer is present in an amount of about 0.25 weight percent of active chemical based on the weight of the tractor fluid as a whole.

The following non-limiting Examples serve to illustrate this invention.

EXAMPLE I

A formulation containing 2.82 percent by weight of an overbased calcium sulfonate salt complex; 3.38 percent by weight of a zinc dithiophosphate; 1 percent by weight of a borated epoxide and 0.5 percent by weight of a carboxylic solubilizer; 1.93 percent by weight of styrene/maleic anhydride VI improver and 0.02 percent by weight of a silicon anti-foam agent dissolved in hydrocarbon oil.

EXAMPLE II

A formulation containing 1.76 percent by weight of an overbased calcium sulfonate salt complex; 2.14 percent by weight of a zinc dithiophosphate treated with triphenylphosphite; 0.63 percent by weight of a borated epoxide and 0.31 percent by weight of a carboxylic solubilizer

as the essential components and including 1.93 percent by weight of a styrene/maleic anhydride VI improver; and 0.02 percent by weight of a silicon anti-foaming agent dissolved in hydrocarbon oil.

EXAMPLE III

A formulation containing 1.41 percent by weight of an overbased calcium sulfonate salt complex; 1.71 percent by weight of a zinc dithiophosphate treated with an olefin; 0.5 percent by weight of a borated epoxide and 0.25 percent by weight of a carboxylic solubilizer as the essential components and 1.93 percent by weight of a styrene/maleic anhydride VI improver; and 0.02 percent by weight of a silicon anti-foaming agent dissolved in hydrocarbon oil.

With respect to each of the examples referred to above some variation is possible with respect to what each of the actual components will be. For example, with respect to the use of an overbased calcium sulfonate salt complex, the actual component utilized might be a calcium sulfonate complex which has been overbased with a calcium compound and then treated with polyisobutylene succinic acid or anhydride having a molecular weight in the range of from about 700 to about 5,000. With respect to the zinc dithiophosphate this component might be a mixture of zinc salts of bis(2-ethylhexyl)dithiophosphate and 2-ethylhexyl carboxylic acid treated with triphenylphosphite. This salt is preferably combined with a stoichiometric excess of zinc, i.e., the salt is preferably over-zincd including about 1.2 to about 1.4 stoichiometric equivalents of zinc. The borated epoxide may be a product obtained as a result of the reaction of boric acid with 1,2-epoxide containing about 16 carbon atoms. The carboxylic solubilizer is the product obtained as a result of a reaction of polybutenyl succinic anhydride with N,N-diethylethanolamine at a molar ratio of about 1:2. In addition, these formulations may include other components depending upon its desired end use. The actual specific chemical compound used for each of the essential components, their amounts, as well as other additional active chemicals will be chosen by those skilled in the art depending upon the specific requirements of the functional fluid being produced. Variations in the amounts and the actual specific type of chemical component will be deducible by those of ordinary skill in the art upon consideration of their needs and a reading of the present description.

Claims

1. A functional fluid comprising:
a major amount of up to 99.5 percent by

weight of a hydrocarbon oil and a minor amount, sufficient to improve characteristics of the fluid, of an additive comprising:

a calcium salt present in an amount of from 0.5 percent to 5.5 percent by weight;

an extreme pressure/antiwear agent in the form of a zinc dithiophosphate present in an amount of 1 percent to 4 percent by weight;

a borated epoxide present in an amount of 0.1 percent to 1.5 percent by weight; and

a carboxylic solubilizer present in an amount of 0.1 percent to 1 percent by weight in the form of a reaction product of polybutenyl succinic anhydride with N,N-diethylethanolamine at a molar ratio of about 1:2;

wherein the percentages are all based on the weight of fluid.

2. A functional fluid according to claim 1 wherein the calcium salt is a calcium sulfonate salt complex which has been overbased with a calcium compound and then treated with polyisobutylene succinic acid or anhydride having a molecular weight in the range of from 700 to 5,000.
3. A functional fluid according to either of claims 1 and 2, wherein the borated epoxide is obtained as a result of the reaction of boric acid with a 1,2-epoxide containing 16 carbon atoms.
4. A functional fluid according to any preceding claim wherein the extreme pressure/antiwear agent is in the form of a mixture of zinc salts of bis(2-ethylhexyl)dithiophosphate and 2-ethylhexanoic acid treated with triphenylphosphite.
5. A functional fluid according to any preceding claim wherein the additive is present in an amount of from 0.5 percent to 19.5 percent by weight of the fluid.
6. A process for the preparation of a functional fluid which comprises combining:
a major amount of up to 99.5 percent by weight of a hydrocarbon oil and a minor amount, sufficient to improve characteristics of the fluid, of an additive comprising:
a calcium salt present in an amount of from 0.5 percent to 5.5 percent by weight;
an extreme pressure/antiwear agent in the form of a zinc dithiophosphate present in an amount of 1 percent to 4 percent by weight;
a borated epoxide present in an amount of 0.1 percent to 1.5 percent by weight; and

as the essential components and including 1.93 percent by weight of a styrene/maleic anhydride VI improver; and 0.02 percent by weight of a silicon anti-foaming agent dissolved in hydrocarbon oil.

EXAMPLE III

A formulation containing 1.41 percent by weight of an overbased calcium sulfonate salt complex; 1.71 percent by weight of a zinc dithiophosphate treated with an olefin; 0.5 percent by weight of a borated epoxide and 0.25 percent by weight of a carboxylic solubilizer as the essential components and 1.93 percent by weight of a styrene/maleic anhydride VI improver; and 0.02 percent by weight of a silicon anti-foaming agent dissolved in hydrocarbon oil.

With respect to each of the examples referred to above some variation is possible with respect to what each of the actual components will be. For example, with respect to the use of an overbased calcium sulfonate salt complex, the actual component utilized might be a calcium sulfonate complex which has been overbased with a calcium compound and then treated with polyisobutylene succinic acid or anhydride having a molecular weight in the range of from about 700 to about 5,000. With respect to the zinc dithiophosphate this component might be a mixture of zinc salts of bis(2-ethylhexyl)dithiophosphate and 2-ethylhexyl carboxylic acid treated with triphenylphosphite. This salt is preferably combined with a stoichiometric excess of zinc, i.e., the salt is preferably over-zinced including about 1.2 to about 1.4 stoichiometric equivalents of zinc. The borated epoxide may be a product obtained as a result of the reaction of boric acid with 1,2-epoxide containing about 16 carbon atoms. The carboxylic solubilizer is the product obtained as a result of a reaction of polybutenyl succinic anhydride with N,N-diethylethanolamine at a molar ratio of about 1:2. In addition, these formulations may include other components depending upon its desired end use. The actual specific chemical compound used for each of the essential components, their amounts, as well as other additional active chemicals will be chosen by those skilled in the art depending upon the specific requirements of the functional fluid being produced. Variations in the amounts and the actual specific type of chemical component will be deducible by those of ordinary skill in the art upon consideration of their needs and a reading of the present description.

Claims

1. A functional fluid comprising:
a major amount of up to 99.5 percent by

weight of a hydrocarbon oil and a minor amount, sufficient to improve characteristics of the fluid, of an additive comprising:

a calcium salt present in an amount of from 0.5 percent to 5.5 percent by weight;
an extreme pressure/antiwear agent in the form of a zinc dithiophosphate present in an amount of 1 percent to 4 percent by weight;
a borated epoxide present in an amount of 0.1 percent to 1.5 percent by weight; and
a carboxylic solubilizer present in an amount of 0.1 percent to 1 percent by weight in the form of a reaction product of polybutenyl succinic anhydride with N,N-diethylethanolamine at a molar ratio of about 1:2;

wherein the percentages are all based on the weight of fluid.

2. A functional fluid according to claim 1 wherein the calcium salt is a calcium sulfonate salt complex which has been overbased with a calcium compound and then treated with polyisobutylene succinic acid or anhydride having a molecular weight in the range of from 700 to 5,000.
3. A functional fluid according to either of claims 1 and 2, wherein the borated epoxide is obtained as a result of the reaction of boric acid with a 1,2-epoxide containing 16 carbon atoms.
4. A functional fluid according to any preceding claim wherein the extreme pressure/antiwear agent is in the form of a mixture of zinc salts of bis(2-ethylhexyl)dithiophosphate and 2-ethylhexanoic acid treated with triphenylphosphite.
5. A functional fluid according to any preceding claim wherein the additive is present in an amount of from 0.5 percent to 19.5 percent by weight of the fluid.
6. A process for the preparation of a functional fluid which comprises combining:
a major amount of up to 99.5 percent by weight of a hydrocarbon oil and a minor amount, sufficient to improve characteristics of the fluid, of an additive comprising:
a calcium salt present in an amount of from 0.5 percent to 5.5 percent by weight;
an extreme pressure/antiwear agent in the form of a zinc dithiophosphate present in an amount of 1 percent to 4 percent by weight;
a borated epoxide present in an amount of 0.1 percent to 1.5 percent by weight; and



a carboxylic solubilizer present in an amount of 0.1 percent to 1 percent by weight in the form of a reaction product of polybutenyl succinic anhydride with N,N-diethylethanolamine at a molar ratio of about 1:2;

wherein the percentages are all based on the weight of fluid.

Patentansprüche

1. Funktionelle Flüssigkeit umfassend:

eine Hauptmenge von bis zu 99,5 Gewichtsprozent eines Kohlenwasserstofföls und einer geringen Menge, ausreichend um die Eigenschaften der Flüssigkeit zu verbessern, eines Additivs, umfassend:

ein Calciumsalz, vorliegend in einer Menge von 0,5 bis 5,5 Gewichtsprozent;

ein Extremdruck-/Antiverschleißmittel in Form eines Zinkdithiophosphats, vorliegend in einer Menge von 1 bis 4 Gewichtsprozent;

ein boriertes Epoxid, vorliegend in einer Menge von 0,1 bis 1,5 Gewichtsprozent und ein carboxyliertes Lösungsmittel, vorliegend in einer Menge von 0,1 bis 1 Gewichtsprozent in Form eines Umsetzungsproduktes von Polybutenylbernsteinsäureanhydrid mit N,N-Diethylethanolamin bei einem Molverhältnis von etwa 1:2;

wobei die Prozentangaben sich alle auf das Gewicht der Flüssigkeit beziehen.

2. Funktionelle Flüssigkeit nach Anspruch 1, wobei das Calciumsalz ein Calciumsulfonatsalzkomplex ist, der mit einer Calciumverbindung überbasisch gemacht wurde und dann mit Polyisobutenylbernsteinsäure oder -anhydrid mit einem Molekulargewicht im Bereich von 700 bis 5.000 behandelt wurde.

3. Funktionelle Flüssigkeit nach einem der Ansprüche 1 und 2, wobei das borierte Epoxid als Ergebnis der Umsetzung von Borsäure mit einem 16 Kohlenstoffatome enthaltendem 1,2-Epoxid erhalten wird.

4. Funktionelle Flüssigkeit nach einem vorangehenden Anspruch, wobei das Extremdruck-/Antiverschleißmittel in Form eines Gemisches aus Zinksalzen von Bis(2-ethylhexyl)-dithiophosphat und mit Triphenylphosphit umgesetzter 2-Ethylhexansäure vorliegt.

5. Funktionelle Flüssigkeit nach einem vorangehenden Anspruch, wobei das Additiv in einer Menge von 0,5 bis 19,5 Gewichtsprozent der Flüssigkeit vorliegt.

6. Verfahren zur Herstellung einer funktionellen Flüssigkeit, umfassend das Zusammengeben: einer Hauptmenge von bis zu 99,5 Gewichtsprozent eines Kohlenwasserstofföls und einer geringen Menge, ausreichend um die Eigenschaften der Flüssigkeit zu verbessern, eines Additivs, umfassend:

ein Calciumsalz, vorliegend in einer Menge von 0,5 bis 5,5 Gewichtsprozent;

ein Extremdruck-/Antiverschleißmittel in Form eines Zinkdithiophosphats, vorliegend in einer Menge von 1 bis 4 Gewichtsprozent,

ein boriertes Epoxid, vorliegend in einer Menge von 0,1 bis 1,5 Gewichtsprozent und

ein carboxyliertes Lösungsmittel, vorliegend in einer Menge von 0,1 bis 1 Gewichtsprozent in Form eines Umsetzungsproduktes von Polybutenylbernsteinsäureanhydrid mit N,N-Diethylethanolamin bei einem Molverhältnis von etwa 1:2;

wobei die Prozentangaben sich alle auf das Gewicht der Flüssigkeit beziehen.

Revendications

1. Fluide fonctionnel comprenant:

une quantité principale allant jusqu'à 99,5 pourcent en poids d'une huile hydrocarbonée et une petite quantité, suffisante pour améliorer les caractéristiques du fluide, d'un additif comprenant:

un sel de calcium présent en une quantité de 0,5 pourcent à 5,5 pourcent en poids;

un agent de pression extrême/antiusure sous la forme d'un dithiophosphate de zinc présent en une quantité de 1 pourcent à 4 pourcent en poids;

un époxyde boraté présent en une quantité de 0,1 pourcent à 1,5 pourcent en poids; et

un agent de solubilisation carboxylique présent en une quantité de 0,1 pourcent à 1 pourcent en poids sous la forme d'un produit obtenu par la réaction d'anhydride polybutényl-succinique avec de la N,N-diéthyléthanolamine à un rapport molaire d'environ 1:2;

dans lequel les pourcentages sont tous par rapport au poids du fluide.

2. Fluide fonctionnel selon la revendication 1, dans lequel le sel de calcium est un complexe de sel de sulfonate de calcium qui a été surdosé avec un composé de calcium et ensuite traité avec un acide ou anhydride polyisobutylénysuccinique ayant une masse moléculaire dans la gamme de 700 à 5 000.



3. Fluide fonctionnel selon la revendication 1 ou 2, dans lequel l'époxyde boraté est obtenu comme résultat de la réaction de l'acide borique avec un 1,2-époxyde contenant 16 atomes de carbone. 5
4. Fluide fonctionnel selon l'une quelconque des revendications précédentes, dans lequel l'agent de pression extrême/antiusure est sous la forme d'un mélange de sels de zinc de bis(2-éthylhexyl)dithiophosphate et d'acide 2-éthylhexanoïque traité avec le triphényle phosphite. 10
5. Fluide fonctionnel selon l'une quelconque des revendications précédentes, dans lequel l'additif est présent en une quantité de 0,5 pourcent à 19,5 pourcent en poids du fluide. 15
6. Procédé pour la préparation d'un fluide fonctionnel qui comprend la combinaison: 20
- d'une quantité principale allant jusqu'à 99,5 pourcent en poids d'une huile hydrocarbonée et une petite quantité, suffisante pour améliorer les caractéristiques du fluide, d'un additif comprenant: 25
 - un sel de calcium présent en une quantité de 0,5 pourcent à 5,5 pourcent en poids;
 - un agent de pression extrême/antiusure sous la forme d'un dithiophosphate de zinc présent en une quantité de 1 pourcent à 4 pourcent en poids; 30
 - un époxyde boraté présent en une quantité de 0,1 pourcent à 1,5 pourcent en poids; et
 - un agent de solubilisation carboxylique présent en une quantité de 0,1 pourcent à 1 pourcent en poids sous la forme d'un produit obtenu par la réaction d'anhydride polybutényle succinique avec de la N,N-diéthyléthanolamine à un rapport molaire d'environ 1:2; 40
- dans lequel les pourcentages sont tous par rapport au poids du fluide.

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