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FUNCTIONAL FLUID COMPOSITION

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ABSTRACT OF THE DISCLOSURE

A functional fluid composition comprising a homogeneous mixture of materials consisting essentiallly of trialkyl phosphate, tricresyl phosphate, trixylenyl phosphate, a viscosity index improver, rust inhibitor, metal deactivator, a dye and an antifoam agent.

This application is a continuation of application Ser. No. 665,736, filed Sept. 6, 1967, and now abandoned.

BACKGROUND OF THE INVENTION

Compositions suitable for special purposes, such as low temperature lubrication and the operation of hydraulic mechanisms, require a combination of properties which ordinary compositions fail to meet in many respects. The properties which are required for safe and satisfactory low temperature operation include low pour points so that the composition will operate at a temperature at least as low as −40° F., to −60° F. Another important property which is desirable for such uses is a flat viscosity temperature curve, that is, a high viscosity index, so that the material is operable over a wide range of temperatures, such as are encountered in the operation of aircraft. One of the key properties which must be considered for both commercial aircraft and military use is minimum flammability. Other inherent qualities include a relatively high boiling point, low corrosion characteristics and low oxidation susceptibility.

Numerous compositions have been suggested for the above purposes. Thus, the lower trialkyl phosphates have been suggested. However, these compositions exhibit high wear characteristics, are somewhat flammable, due in part to their volatility, and at low temperatures exhibit incompatibility with ordinary thickeners. In order to overcome these undesirable characteristics, it has been proposed to modify the trialkyl phosphates by adding thereto a small amount of ketone. However, the addition of the ketones do not impart to the fluid the properties as required for the functional fluids. An example of such a composition is described in U.S. Pat. 2,470,792.

Another attempt to employ the trialkyl phosphates has been to add thereto a small amount of triaryl phosphate such as diphenyl cresyl phosphate a certain proportion of a linear polymer of methacrylic acid esters and a small amount of an epoxide composition such as glycidyl hydrocarbyl ethers and hydrocarbon epoxides, see Pat. No. 2,636,861. However, these materials have not been notably successful in the performance as functional fluids in aircraft because these materials lack all the combined aforementioned properties.

BRIEF DESCRIPTION OF THE INVENTION

It has been discovered that the trialkyl phosphates can be successfully employed as functional fluids when combined with certain other materials within certain limitations to provide the properties for the functional fluid. Thus, the trialkyl phosphate can be combined with tricresyl phosphate, trixylenyl phosphate, a viscosity index improver such as polymethacrylate, a rust inhibitor, a metal deactivator in certain proportions to provide a unique combination of materials that can be used as functional fluid and be provided with the requisite properties.

DETAILED DESCRIPTION OF THE INVENTION

The trialkyl phosphates useful with the present invention are present in amounts from about 50 to about 90% by weight and preferably from about 65 to about 75% by weight. The trialkyl phosphates which give optimum results are those wherein each of the alkyl groups contain from 3 to 12 carbon atoms, preferably from 4 to 9 carbon atoms. The alkyl groups must be of a straight chained configuration. A single trialkyl phosphate may contain the same alkyl group in all three positions or may possess a mixture of different alkyl groups. Mixtures of various trialkyl phosphate may be used. Suitable species of trialkyl phosphates which are employed in the composition of the present invention include tripropyl phosphates, tributyl phosphates, trihexyl phosphates, trioctyl phosphates, dipropyl octylphosphate, dibutyl octyl phosphate, dipropyl hexyl phosphate, dihexyl octyl phosphate, dihexyl propyl phosphate, propyl butyl octyl phosphate.

The trialkyl phosphates of the present invention must be combined with at least one base stock material comprising tricresyl phosphate or trixylenyl phosphate but preferably consisting of a combined mixture of tricresyl phosphate and trixylenyl phosphate which function also as a thickener. Thus, the amount of tricresyl phosphate is in the range between about 0 to about 25% while the trixylenyl phosphate is in the range between about 0 and about 25% by weight, preferably about 5 to about 15% tricresyl phosphate and about 5 to about 15% tricresyl phosphate. The combined mixture of tricresyl phosphate and trixylenyl phosphate are blended together to provide a viscosity of between about 145 to 230 Saybolt Universal Seconds measured at 100° F. This blend of materials can then be combined with the trialkyl phosphate in any known manner.

A conventional polymeric material is then blended with the mixture of trialkyl phosphate and base stock material which polymeric material functions as a viscosity index improver. The polymeric material useable with the present invention is a mixture of from about 10 to about 55% by weight polymethacrylates, polyacrylates each containing from 1 to 20 carbon atoms. The polymeric materials may be within a solvent carrier such as di-2-ethyl hexyl sebacate, dioctyl adipate, di-2-ethyl hexyl adipate or other conventional carriers. The polymeric material may be any combination of these materials. This material is thoroughly blended with the combination of ingredients to form a uniform material. The amount of material is in the range between about 5 and about 20% by weight.

Thereafter, a rust inhibitor within a solvent carrier such as an alkyl succinic acid and their derivatives is blended with the materials. This latter material is essential to the present invention and is present in amounts between about 0.01 and about 0.5% by weight. Thereafter, a corrosion inhibitor such as benzotriazole, quinizarin or the like in an amount ranging between about 0.001 and about 0.5% by weight is added to the mixture and thoroughly blended therewith. Then, a dye which may range between 5 and 20 parts per million is added thereto and blended therewith as is conventional in the art. Also a conventional silicon antifoaming agent is added thereto which may range between 5 and 50 parts per million.

The above mixture of components has the requisite properties to be useable as a functional fluid.

The functional fluids may be prepared in a manner illustrated in the following examples:

Example 1

A base stock material consisting of tricresyl phosphate in an amount of 10.45 weight percent was thoroughly blended with 8.55 weight percent of trixylenyl phosphate to attain a viscosity of 155 Saybolt Universal Seconds measured at 100° F. This blend of materials was blended with 68.96 weight percent of tributyl phosphate until the materials were throughly intermixed. Thereafter, 12 weight percent of a mixture of about 40% of a polyalkyl methacrylate and about 60% di-2-ethyl hexyl sebacate solvent carrier were thoroughly blended therewith. Then, a conventional alkyl succinic acid rust inhibitor in an amount of 0.02 weight percent within a solvent carrier was blended therewith. Then, 0.02 weight percent of benzotriazole was thoroughly blended therewith along with a conventional dye and antifoam agent in an amount of 10 parts per million and 15 parts per million, respectively. After the above ingredients were thoroughly blended together to form a homogeneous mixture of materials, the functional fluid was thoroughly tested to give the following properties:

TABLE I.—TYPICAL PROPERTIES

Appearance	Blue
Specific gravity, 60° F. (ASTM D–1298)	1.011
Refractive index, 77° F. (ASTM D–1218)	1.4476
Viscosity:	
Cs. at 210° F.	3.40
Cs. at 100° F.	10.22
Cs. at −65° F.	1550
(ASTM D–445).	
Viscosity index, calc.	216
(ASTM D–2270) tables	264
Pour point ° F. (ASTM D–97)	Below −80
Neutralization No. mgs. KOH/gm. (ASTM D–974)	0.13
Water, wt. percent (ASTM D–1744)	0.10

TABLE II.—FIRE PROPERTIES

Flash point, ° F. (ASTM D–92)	340
Fire point, ° F. (ASTM D–92)	380
Autogenous ignition temperature, ° F. (ASTM D–286)	1025
Manifold ignition, ° F.	1300

TABLE III.—CHEMICAL STABILITY

Hydrolytic stability—48 hours at 200° F. (Fed. Test Method Std. No. 791a Method 3457)

Metal weight loss: mg./cm.^{2}	0.262
Neutralization No. Change:	
Mg. KOH/gm. fluid	+2.05
Mg. KOH water	+17.0

TABLE IV.—CHEMICAL STABILITY

Oxidation Corrosion Stability

	168 hours at—	
	180° F.	250° F.
Percent viscosity change at 100° F.	+2.6	+4.2
NN change, mg. KOH/gm	+0.85	+0.24
Metals, wt. change, mg./cm.:		
Copper	−0.027	−0.477
Low carbon steel	0.0	−0.019
Aluminum alloy	0.0	−0.010
Magnesium alloy	−1.59	−0.050
Cadmium plated steel	−0.015	−0.231

TABLE V.—THERMAL STABILITY

(Fed. Test Method Std. No. 791a Method 2508)
(24 hours at 400° F.)

Viscosity change cs. at 100° F.	−0.65
NN change, mg. KOH/gm.	+5.34

TABLE VI.—SHEAR STABILITY

Viscosity loss at 100° F. (percent), shear time:	
15 min.	8.5
30 min.	11.2
45 min.	12.9
90 min.	17.1
120 min.	17.4
150 min.	17.3

TABLE VII.—STORAGE STABILITY

(a) 7 days at −50° F.:	
Viscosity change, cs. at 100° F.	+0.02
NN change, mg. KOH/gm.	0.0
(b) 7 days at 180° F.:	
Viscosity change, cs. at 100° F.	−0.34
NN change, mg. KOH/gm.	+0.22

TABLE VIII.—FOAMING TENDENCIES
(ASTM D–892)

Sequence I, 75° F.:	
Tendency, ml.	0
Stability, sec.	—
Sequence II, 200° F.:	
Tendency, ml.	10
Stability, sec.	5
Sequence III, 75° F.:	
Tendency, ml.	0
Stability, sec.	—

TABLE IX.—LUBRICITY

(a) Four Ball (ASTM D–2266) 600 r.p.m., 1 hour at 167° F., steel on steel:	
Mm. scar, 1 kg. load	0.15
Mm. scar, 40 kg. load	0.60
Steel on bronze:	
Mm. scar, 1 kg. load	0.20
Mm. scar, 40 kg. load	0.70
(b) Falex extreme pressure	(Seizure)
Load, lbs.	1900
Torque, in.-lbs.	50

TABLE X.—COMPATIBILITY WITH ELASTOMERS

(Fed. Test Method Std. No. 791a Method 3604)

Ethylene propylene rubber percent swell	11.3
Butyl rubber, percent swell	8.0

Example 2

The thermal stability of a conventional functional fluid was tested and compared to the fluid of the present invention. Thus, a sample of a commercially available material was obtained and tested in accordance with the procedures outlined in Table V. The active material was octyl diphenylphosphate. The viscosity change measured in centistrokes at 100° F. was −0.25 while the neutralization number change measured in milligrams potassium hydroxide per gram was +7.57. A comparison to the thermal stability as indicated in Table 5 of Example 1 illustrates the superiority of the fluid of the present invention.

While specific details of the present invention have been set forth herein, it is understood that variations in amounts and the addition of other materials are within the scope of the invention. Specifically, up to 5% water may be added if desired.

What is claimed is:

1. A composition useful as a base stock in hydraulic fluids which consists essentially of at least 50 to about 90% by weight of a tiralkyl phosphate selected from the group consisting of tripropyl phosphate, tributyl phosphate, trihexyl phosphate, trioctyl phosphate, dipropyl octyl phosphate, dibutyl octyl phosphate, dipropyl hexyl phosphate, dihexyl octyl phosphate, dihexyl propyl phosphate, propyl butyl octyl phosphate and mixtures thereof, and a mixture of from about 5 to about 25% by weight of tricresyl phosphate and from about 5 to about 25% by

weight of trixylenyl phosphate, said mixture of tricresyl and trixylenyl phosphates having a viscosity of between about 145 to about 230 Saybolt Universal Seconds measured at 100° F.

2. The base stock of claim 1 in which said trialkyl phosphate is present in an amount from about 65 to about 75% by weight and said tricresyl and trixylenyl phosphates are each present in amounts from about 5 to about 15% by weight.

3. A hydraulic fluid consisting essentially of the base stock in accordance with claim 1 and additionally containing from about 5 to about 20% by weight of a polymethacrylate viscosity index improver, from about 0.01 to about 0.5% by weight of an alkyl succinic acid and from about 0.001 to about 0.5% of a corrosion inhibitor selected from the group consisting of benzotriazole and quinizarin.

4. The hydraulic fluid of claim 3 additionally containing between about 5 to about 20 parts per million of a dye and between about 5 to about 50 parts per million of an antifoaming agent.

5. The hydraulic fluid of claim 3 additionally containing up to about 5% by weight water.

6. A composition useful as a hydraulic fluid consisting essentially of from about 65 to about 75% by weight of tributyl phosphate, a mixture of from about 5 to about 15% tricresyl phosphate and from about 5 to about 15% trixylenyl phosphate, said mixture of tricresyl and trixylenyl phosphates having a viscosity between about 145 to about 230 Saybolt Universal Seconds measured to 100° F., from about 5 to about 20% by weight of a polymethacrylate viscosity index improver containing an alkyl moiety having up to 20 carbon atoms, from about 0.001 to about 0.5% by weight of benzotriazole, from between about 5 to about 20 parts per million of a dye, and between about 5 to about 50 parts per million of an antifoaming agent.

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