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(54) **LUBRICANT COMPOSITION AND LUBRICANT COMPOSITION PRODUCTION METHOD**

(57) Provided are a lubricant composition in which low friction and low abrasion are compatible in various temperatures and loads, and a manufacturing method of a lubricant composition. A lubricant composition of the present invention contains at least trivalent or more polyol a1; a mixture b1 of at least one of a polymerization reaction mixture of an unsaturated fatty acid having 18 to 22 carbon atoms which contains at least 75 mass% of a divalent carboxylic acid having 36 to 44 carbon atoms or a mixture obtained by performing hydrogenation with respect to the polymerization reaction mixture; and composite ester A containing polyester in which monool c1 represented by General Formula (1) described below is condensed, in which a feed ratio of the number of moles of a hydroxyl group of a1/the number of moles of a carboxylic acid of b1/the number of moles of a hydroxyl group of c1 is 1/1.5 to 2.0/0.7 to 1.5, and a content of the composite ester A is 0.1 to 5 mass% with respect to the total mass of the lubricant composition.

General Formula (1):

R-OH

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Description**BACKGROUND OF THE INVENTION**

1. Field of the Invention

[0001] The present invention relates to a lubricant composition. More specifically, the present invention relates to a lubricant composition containing specific composite ester in which low frictional properties and low abrasive properties are compatible.

2. Description of the Related Art

[0002] Recently, in a lubricant (a lubricant composition), low friction has been required from the viewpoint of reducing an energy loss. In particular, in an automobile, a reduction in fuel consumption has been strongly required from the viewpoint of reducing discharge of carbon dioxide gas, and attaining low friction in engine oil becomes extremely important. In general, a fluid lubrication state in which fluid oil exists between friction surfaces, a boundary lubrication state in which friction surfaces are in contact with each other, and thus, are easily abraded, and a mixed lubrication state which is an intermediate state between the states described above are known as a frictional state.

[0003] In a case of a lubricant composition for an internal combustion engine, oil film shortage easily occurs at the time of performing engine initiation, and thus, the boundary lubrication state is easily formed. A viscosity of the lubricant composition is high from the initiation until an oil temperature increases, and thus, viscosity resistance is large, and an energy loss occurs. In addition, an increase in the oil temperature and friction at a low speed simultaneously occur at the time of performing idling, and thus, the boundary lubrication state is easily formed. In addition to the internal combustion engine application, the lubricant composition is required to exhibit excellent friction properties at various temperatures and in various load regions.

[0004] In general, the lubricant composition contains base oil and various additives. Examples of the base oil include mineral oil obtained from crude oil, ester-based oil which is chemically synthesized, fluorine-based oil, poly α olefin-based oil, and the like. Among them, the ester-based oil is preferably used in a jet plane, automobile engine oil, grease, and the like from the viewpoint of a low pour point, a high viscosity index, a high ignition point, excellent lubrication properties, biodegradability, and the like.

[0005] It is known that the ester-based oil is used as base oil or an additive. For example, various esters such as monoester obtained from a reaction between an aliphatic monocarboxylic acid and monohydric alcohol; diester obtained from a reaction between an aliphatic dicarboxylic acid and monohydric alcohol; polyol ester obtained from a reaction between polyhydric alcohol and an aliphatic carboxylic acid; and composite ester obtained from a reaction between polyol, a polybasic acid, and an aliphatic monocarboxylic acid have been disclosed (JP2002-097482A, JP2005-154726A, JP2005-232434A, JP2005-213377A, JP2005-232470A, JP2001-501989A, JP2001-500549A, JP2001-507334A, and JP2002-530476A).

SUMMARY OF THE INVENTION

[0006] The lubricant composition is required to exhibit excellent friction properties at various temperatures and in various load regions. In order to attain excellent friction properties (low friction), a reduction in viscosity resistance of the lubricant composition, that is, low friction in the fluid lubrication state according to low viscosity is effective, but in a case where the lubricant composition has a low viscosity, a device deteriorates due to abrasion in the boundary lubrication state.

[0007] In order to attain low friction and low abrasion, it is considered that various ester-based compositions are added into the lubricant composition at a predetermined ratio. However, even in the lubricant composition using the ester-based composition as described above, low friction and low abrasion are not sufficiently compatible, and thus, it is difficult to make low friction and low abrasion compatible at various temperatures and various loads. For this reason, a lubricant composition exhibiting more excellent lubrication properties, a low viscosity, low frictional properties in the fluid lubrication state, and low abrasive properties in the boundary lubrication state such as a high temperature and a high load is required.

[0008] An object of the present invention is to provide a lubricant composition in which low frictional properties and low abrasive properties are compatible at various temperatures and various loads.

[0009] As a result of various studies of the present inventors for attaining the object described above, it has been found that a lubricant composition which contains composite ester A containing polyester obtained by feeding and condensing alcohol and a carboxylic acid at a specific ratio in a specific amount can exhibit low abrasive properties and low frictional properties even in rigorous conditions such as a high temperature and/or a high pressure.

[0010] That is, the object described above is attained by the present invention having the following configuration.

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[1] A lubricant composition, containing at least: trivalent or more polyol a1; a mixture b1 of at least one of a polymerization reaction mixture of an unsaturated fatty acid having 18 to 22 carbon atoms which contains at least 75 mass% of a divalent carboxylic acid having 36 to 44 carbon atoms or a mixture obtained by performing hydrogenation with respect to the polymerization reaction mixture; and composite ester A containing polyester in which monool c1 represented by General Formula (1) described below is condensed, in which a feed ratio of the number of moles of a hydroxyl group of a1/the number of moles of a carboxylic acid of b1/the number of moles of a hydroxyl group of c1 is 1/1.5 to 2.0/0.7 to 1.5, and a content of the composite ester A is 0.1 to 5 mass% with respect to the total mass of the lubricant composition.

General Formula (1): $R-OH$

In General Formula (1), R represents a linear alkyl group having greater than or equal to 8 carbon atoms or a branched alkyl group having greater than or equal to 8 carbon atoms.

[2] The lubricant composition according to [1], in which in General Formula (1) described above, R is a linear alkyl group having 8 to 25 carbon atoms or a branched alkyl group having 8 to 25 carbon atoms.

[3] The lubricant composition according to [1] or [2], in which in General Formula (1) described above, R is a linear alkyl group having 16 to 20 carbon atoms or a branched alkyl group having 16 to 20 carbon atoms.

[4] The lubricant composition according to any one of [1] to [3], in which in General Formula (1) described above, R is a branched alkyl group.

[5] The lubricant composition according to any one of [1] to [4], in which the content of the composite ester A is 0.5 to 2 mass% with respect to the total mass of the lubricant composition.

[6] The lubricant composition according to any one of [1] to [5], in which in a case in which the total number of moles of the hydroxyl group of the number of moles of the hydroxyl group of a1 and the number of moles of the hydroxyl group of c1 is set to P, and the number of moles of the carboxylic acid of b1 is set to Q, a feed ratio of P/Q is 1/0.7 to 0.95.

[7] The lubricant composition according to any one of [1] to [6], in which a kinematic viscosity of the composite ester A at 40°C is 500 to 2,000 mm²/s.

[8] The lubricant composition according to any one of [1] to [7], in which the kinematic viscosity at 40°C is 5 to 100 mm²/s.

[9] The lubricant composition according to any one of [1] to [8], further containing: a medium, in which 0.1 to 5 mass% of the composite ester A is contained, and 70 to 99.9 mass% of the medium is contained, with respect to the total mass of the lubricant composition, and 0 to 29.9 mass% of other components other than the composite ester A and the medium are contained with respect to the total mass of the lubricant composition.

[10] The lubricant composition according to [9], in which the medium is at least one type selected from mineral oil, polyolefin oil, ester oil, and ether oil.

[11] The lubricant composition according to [9] or [10], in which the other components are compounds having at least one type of zinc, molybdenum, sulfur, or phosphorus as a constituent element.

[12] The lubricant composition according to any one of [9] to [11], in which the other components are at least one type of an organic molybdenum compound or an organic zinc compound.

[13] The lubricant composition according to any one of [1] to [12], in which the lubricant composition is used as lubricating oil for grease, a releasing agent, oil for an internal combustion engine, oil for metal working (cutting), bearing oil, fuel for a combustion engine, vehicle engine oil, gear oil, operating oil for an automobile, lubricating oil for a vessel and an aircraft, machine oil, turbine oil, hydraulic operating oil, compressor and vacuum pump oil, freezer oil, a lubricating oil agent for metal working, a lubricant for a magnetic recording medium, a lubricant for a micro machine, a lubricant for an artificial bone, or rolling oil.

[14] A manufacturing method of a lubricant composition, comprising: obtaining a composite ester A; and obtaining a lubricant composition in which a concentration of the composite ester A is 0.1 to 5 mass%, in which the obtaining the composite ester A is mixing and condensing at least trivalent or more polyol a1, a mixture b1 of at least one of a polymerization reaction mixture of an unsaturated fatty acid having 18 to 22 carbon atoms which contains at least 75 mass% of a divalent carboxylic acid having 36 to 44 carbon atoms or a mixture obtained by performing hydrogenation with respect to the polymerization reaction mixture, and monool c1 represented by General Formula (1) described below such that the number of moles of a hydroxyl group of a1/the number of moles of a carboxylic acid of b1/the number of moles of a hydroxyl group of c1 becomes 1/1.5 to 2.0/0.7 to 1.5.

General Formula (1): $R-OH$

[0011] In General Formula (1), R represents a linear alkyl group having greater than or equal to 8 carbon atoms or a

branched alkyl group having greater than or equal to 8 carbon atoms.

[0012] The lubricant composition of the present invention can exhibit low frictional properties and low abrasive properties at various temperatures and various loads. The lubricant composition of the present invention can excellently exhibit a low viscosity, low frictional properties in a fluid lubrication state, and low abrasive properties even in a boundary lubrication state such as a high temperature and a high load.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] Hereinafter, the present invention will be described in detail. The following description of configuration requirements are based on representative embodiments or specific examples, but the present invention is not limited to the embodiments. Furthermore, herein, a numerical range represented by using "to" indicates a range including the numerical values before and after "to" as the lower limit value and the upper limit value.

(Lubricant Composition)

[0014] A lubricant composition of the present invention relates to a lubricant composition containing at least trivalent or more polyol a1, a mixture b1 of at least one of a polymerization reaction mixture of an unsaturated fatty acid having 18 to 22 carbon atoms which contains at least 75 mass% of a divalent carboxylic acid having 36 to 44 carbon atoms or a mixture obtained by performing hydrogenation with respect to the polymerization reaction mixture, and composite ester A containing polyester in which monool c1 represented by General Formula (1) described below is condensed. Here, a feed ratio of the number of moles of a hydroxyl group of a1/the number of moles of a carboxylic acid of b1/the number of moles of a hydroxyl group of c1 is 1/1.5 to 2.0/0.7 to 1.5, and a content of the composite ester A is 0.1 to 5 mass% with respect to the total mass of the lubricant composition.

R-OH General Formula (1)

[0015] In General Formula (1), R represents a linear alkyl group having greater than or equal to 8 carbon atoms or a branched alkyl group having greater than or equal to 8 carbon atoms.

[0016] The composite ester A used in the lubricant composition of the present invention is obtained by feeding and performing a condensation reaction an a1 component to a c1 component such that the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of c1 becomes 1/1.5 to 2.0/0.7 to 1.5, preferably becomes 1/1.55 to 1.9/0.8 to 1.4, and more preferably becomes 1/1.60 to 1.8/0.8 to 1.3.

[0017] Further, in a case where the total number of moles of the hydroxyl group of the number of moles of the hydroxyl group of a1 and the number of moles of the hydroxyl group of c1 is set to P, and the number of moles of the carboxylic acid of b1 is set to Q, a feed ratio of P/Q is preferably 1/0.7 to 1.0, is more preferably 1/0.75 to 0.95, and is even more preferably 1/0.8 to 0.9. That is, it is preferable that composite ester A can be obtained by feeding each of the components such that a feed ratio of the total number of moles of the hydroxyl group/the total number of moles of the carboxylic acid is in the range described above.

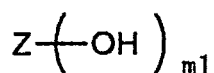
[0018] Thus, each of the components is fed at a specific ratio, and is condensed, and thus, a degree of crosslinkage, a viscosity, an acid value, a residual amount of monool, and the like of the obtained composite ester A can have optimal values. For this reason, it is possible to suppress abrasion by only adding a trace amount of the composite ester A into base oil or the like, and thus, the lubricant composition can exhibit abrasion resistance while maintaining viscosity properties of the base oil. In addition, in the present invention, in both of a fluid lubrication state and a boundary lubrication state, excellent friction properties can be obtained.

[0019] The content of the composite ester A may be 0.1 to 5 mass%, is preferably 0.3 to 3 mass%, and is more preferably 0.5 to 2 mass%, with respect to the total mass of the lubricant composition. Thus, excellent lubrication properties are exhibited by only adding a small amount of the composite ester A into the lubricant composition.

(Trivalent or more Polyol a1)

[0020] The trivalent or more polyol a1 (the a1 component or also simply referred to as a1) is a compound containing greater than or equal to 3 alcoholic hydroxyl groups and/or greater than or equal to 3 phenolic hydroxyl groups in the molecules, is preferably a compound containing greater than or equal to 3 alcoholic hydroxyl groups, and is more preferably a compound containing 3 to 6 alcoholic hydroxyl groups.

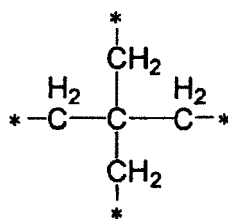
[0021] Preferred trivalent or more polyol a1 is alcohol represented by General Formula (a1-1) described below.



General Formula (a1-1)

[0022] In General Formula (a1-1), Z represents an m1-valent linking group, and m1 represents an integer of greater than or equal to 3, is preferably 3 to 6, and is more preferably 3 or 4.

[0023] Z is preferably an aliphatic linking group, and is more preferably an alkylene linking group which may be linked by an oxygen atom. The number of carbon atoms of the alkylene linking group is preferably 2 to 20, is more preferably 2 to 15, is even more preferably 3 to 10, and is particularly preferably 5 to 7. In addition, it is more preferable that Z is a linking group having a neopentyl partial structure represented by Structural Formula (Z-1) described below from the viewpoint of reducing friction at a high temperature.



(Z-1)

[0024] In Structural Formula (Z-1) described above, * represents a bonding position with respect to a hydroxyl group or other substituents.

[0025] More preferred examples of the trivalent or more polyol a1 include trivalent polyol such as trimethylol ethane, trimethylol propane, and glycerin, tetravalent polyol such as pentaerythritol, ditrimethylol ethane, and ditrimethylol propane, and pentavalent or more polyol such as dipentaerythritol, trimethylol ethane and trimethylol propane are particularly preferable.

[0026] (Mixture b1 of at least One of Polymerization Reaction Mixture of Unsaturated Fatty Acid Having 18 to 22 Carbon Atoms which Contains at least 75 mass% of Divalent Carboxylic Acid Having 36 to 44 Carbon Atoms or Mixture Obtained by Performing Hydrogenation with respect to Polymerization Reaction Mixture)

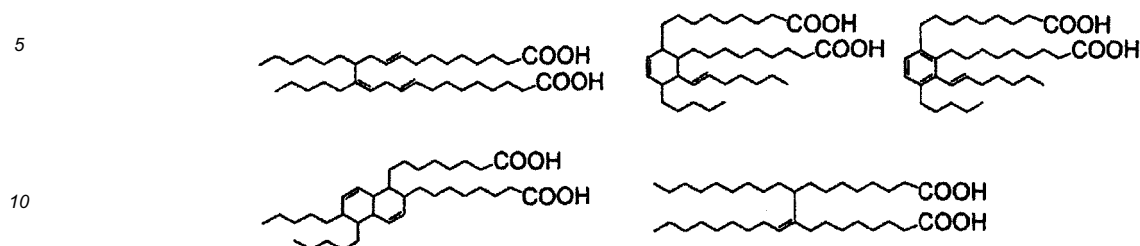
[0027] The mixture b1 of at least one of the polymerization reaction mixture of the unsaturated fatty acid having 18 to 22 carbon atoms which contains at least 75 mass% of the divalent carboxylic acid having 36 to 44 carbon atoms or the mixture obtained by performing the hydrogenation with respect to the polymerization reaction mixture (the b1 component or also simply referred to as b1) contains at least 75 mass% of the divalent carboxylic acid having 36 to 44 carbon atoms. The b1 component preferably contains at least greater than or equal to 80 mass% of the divalent carboxylic acid having 36 to 44 carbon atoms, more preferably contains greater than or equal to 85 mass% of the divalent carboxylic acid having 36 to 44 carbon atoms, even more preferably contains greater than or equal to 90 mass% of the divalent carboxylic acid having 36 to 44 carbon atoms, and particularly preferably contains greater than or equal to 94 mass% of the divalent carboxylic acid having 36 to 44 carbon atoms. That is, the b1 component can contain the divalent carboxylic acid having 36 to 44 carbon atoms as a main component. The polymerization reaction mixture of the unsaturated fatty acid having 18 to 22 carbon atoms which is industrially available may contain a monocarboxylic acid and a tricarboxylic acid in addition to the divalent carboxylic acid, and the b1 component used in the present invention contains the divalent carboxylic acid in the amount of greater than or equal to the range described above with respect to the total mass of the polymerization reaction mixture.

[0028] Examples of the unsaturated fatty acid having 18 to 22 carbon atoms which becomes a raw material of b1 include an unsaturated fatty acid having 18 carbon atoms such as a petroselinic acid, an oleic acid, an elaidic acid, a vaccenic acid, a linoleic acid, a linolenic acid, an α -eleostearic acid, a β -eleostearic acid, a punicic acid, and a parinaric acid (preferably, an oleic acid and a linoleic acid), an unsaturated fatty acid having 20 carbon atoms such as a gadoleic acid and an arachidonic acid, and an unsaturated fatty acid having 22 carbon atoms such as a cetoleic acid and an erucic acid (preferably, an erucic acid). By polymerizing one type or two or more types thereof, the polymerization reaction mixture can be obtained. It is preferable that the polymerization reaction mixture is purified such that the content of the divalent carboxylic acid becomes greater than or equal to 75 mass% by a method such as distillation.

[0029] In particular, the b1 component preferably contains greater than or equal to 75 mass% of a dimerized substance of an unsaturated fatty acid having 18 carbon atoms, a so-called dimer acid, or a dimerized substance of an unsaturated fatty acid having 22 carbon atoms, and particularly preferably contains greater than or equal to 75 mass% of the dimer acid.

[0030] Here, the dimer acid indicates an aliphatic dicarboxylic acid or an alicyclic dicarboxylic acid generated by dimerizing an unsaturated fatty acid (in general, the number of carbon atoms is 18) according to polymerization, a DIELS-

ALDER reaction, or the like. The dimer acid contains a plurality of structural isomers. For example, the following structures can be exemplified as a structure of a compound contained in the dimer acid.



[0031] Specific examples of the dimer acid include TSUNODYMES (Registered Trademark) 205, 216, 228, and 395 manufactured by TSUNO CO., LTD., and products manufactured by BASF SE, UNIQEMA LIMITED, and Croda International P1c may be used.

[0032] The mixture b1 may contain the mixture obtained by performing the hydrogenation with respect to the polymerization reaction mixture. That is, a polymerization reaction mixture of which a carbon-carbon double bond is reduced by a method such as hydrogenation may be used as the polymerization reaction mixture. By using such a polymerization reaction mixture, oxidative resistance of a lubricant composition to be obtained is improved. Examples of the hydrogenated dimer acid include PRIPOLS 1006, 1009, and the like manufactured by Croda International P1c. The mixture b1 may be a polymerization reaction mixture obtained by being hydrogenated, or may be a mixture of a polymerization reaction mixture obtained by being hydrogenated and a polymerization reaction mixture which is not hydrogenated.

[0033] Specific examples of the polymerization reaction mixture of the unsaturated fatty acid having 22 carbon atoms include a dimerized substance of an erucic acid. Specific examples of the dimerized substance of the unsaturated fatty acid having 22 carbon atoms include PRIPOL 1004 manufactured by Croda International P1c.

(Monool c1)

[0034] The monool c1 (the c1 component or also simply referred to as c1) is represented by General Formula (1) described below.

R-OH General Formula (1)

[0035] In General Formula (1), R represents a linear alkyl group having greater than or equal to 8 carbon atoms or a branched alkyl group having greater than or equal to 8 carbon atoms. The number of carbon atoms of each of the linear alkyl group and the branched alkyl group represented by R may be greater than or equal to 8, is preferably greater than or equal to 10, and is more preferably greater than or equal to 14. In addition, the number of carbon atoms of each of the linear alkyl group and the branched alkyl group represented by R is preferably 8 to 25, is more preferably 14 to 25, and is even more preferably 16 to 20. Furthermore, it is preferable that the linear alkyl group and the branched alkyl group represented by R is a non-substituted linear alkyl group or a non-substituted branched alkyl group.

[0036] A branched alkyl group is preferable as the alkyl group represented by R. R is more preferably a branched alkyl group having 8 to 25 carbon atoms, and is even more preferably a branched alkyl group having 16 to 20 carbon atoms. By setting an alkyl group represented by R to have a branched structure, it is possible to suppress temperature dependency of a viscosity of composite ester to be small, and it is possible to exhibit excellent lubrication properties in various temperature regions.

[0037] Specific examples of the monool c1 include octanol, decanol, tridecanol, hexadecanol, octadecanol, 2-ethyl hexanol, 2-hexyl-1-decanol, branched alkyl monool having 14 carbon atoms, branched alkyl monool having 16 carbon atoms, branched alkyl monool having 18 carbon atoms, branched alkyl monool having 20 carbon atoms, and the like. Specific examples of the monool c1 having a more preferred branched alkyl group include 2-ethyl hexanol, 2-hexyl-1-decanol, branched alkyl monool having 14 carbon atoms (for example, FINEOXOCOL 140N manufactured by Nissan Chemical Industries, Ltd.), branched alkyl monool having 16 carbon atoms (for example, FINEOXOCOL 1600 manufactured by Nissan Chemical Industries, Ltd.), branched alkyl monool having 18 carbon atoms (for example, FINEOXOCOL 180 series manufactured by Nissan Chemical Industries, Ltd.), and branched alkyl monool having 20 carbon atoms (for example, FINEOXOCOL 2000 manufactured by Nissan Chemical Industries, Ltd.). Among them, the 2-hexyl-1-decanol, the branched alkyl monool having 16 carbon atoms (for example, FINEOXOCOL 1600 manufactured by Nissan Chemical Industries, Ltd.), the branched alkyl monool having 18 carbon atoms (for example, FINEOXOCOL 180 series manufactured by Nissan Chemical Industries, Ltd.), and the branched alkyl monool having 20 carbon atoms (for example, FINEOXOCOL 2000 manufactured by Nissan Chemical Industries, Ltd.) are preferably used.

(Other Components)

[0038] In the composite ester A, other components other than a1 to c1 may be used as another condensation raw material. Further, divalent alcohol (preferably, aliphatic divalent alcohol having 2 to 40 carbon atoms), a monovalent carboxylic acid (preferably, an aliphatic carboxylic acid having greater than or equal to 4 carbon atoms, and more preferably an aliphatic carboxylic acid having greater than or equal to 8 carbon atoms), and a divalent carboxylic acid other than b1 (preferably, an aliphatic dicarboxylic acid having 4 to 10 carbon atoms) can be exemplified as the another condensation raw material.

(Composite Ester A)

[0039] The composite ester A can be obtained by mixing at least the above-described trivalent or more polyol a1, the above-described mixture b1 of at least one of the polymerization reaction mixture of the unsaturated fatty acid having 18 to 22 carbon atoms which contains at least 75 mass% of the divalent carboxylic acid having 36 to 44 carbon atoms or the mixture obtained by performing the hydrogenation with respect to the polymerization reaction mixture, and the above-described monool c1 represented by R-OH (R is a linear alkyl group having greater than or equal to 8 carbon atoms or a branched alkyl group having greater than or equal to 8 carbon atoms), and by condensing the mixture. The composite ester A contains at least polyester in which the above-described a1 component, the b1 component, and the c1 component are condensed.

[0040] The composite ester A is a mixture containing at least polyester in which a1 to c1 are randomly condensed, and the composite ester A, for example, contains a light component having only one structure derived from the b1 component, or an oligomer component or a polymer component having two or more structures derived from the b1 component. Specifically, examples of the light component can include monoester or diester which can be obtained by a reaction between one or two of two carboxylic acids of the divalent carboxylic acid which is the main component of b1 and the monool of the c1 component. The polyester contained in the composite ester A has a structure derived from the a1 component, and thus, it is possible to form a crosslinking structure, and it is possible to improve lubrication properties. Further, it is preferable that the composite ester A contains polyester having two or more structures derived from the a1 component. By having a plurality of structures derived from the a1 component which is a crosslinking component, it is possible to form a 3-dimensional crosslinking structure, and the lubrication properties are further improved. The content of the oligomer component or the polymer component excluding the light component is preferably greater than or equal to 50%, is more preferably 60% to 85%, and is even more preferably 65% to 80%, in an area ratio of GPC.

[0041] The molecular weight of the composite ester A described above is preferably 1,000 to 100,000, is more preferably 2,000 to 20,000, and is even more preferably 3,000 to 10,000, in a weight-average molecular weight in terms of standard polystyrene using a gel permeation chromatography (GPC). Furthermore, the molecular weight of the composite ester A is the average of the molecular weights of each of the polyester in which a1 to c1 are randomly condensed, the light component described above, and the oligomer component or the polymer component. By setting the molecular weight to be in a suitable range, it is possible to obtain excellent lubrication properties at a low viscosity. Herein, a value measured in the following conditions is specifically adopted as the weight-average molecular weight in terms of polystyrene.

[0042] A "HLC-8220GPC (manufactured by TOSOH CORPORATION) device", and three columns of "TSKgel, SuperH2M-H (manufactured by TOSOH CORPORATION, 4.6 mmID x 15 cm)", "TSKgel, SuperHZ4000 (manufactured by TOSOH CORPORATION, 4.6 mmID x 15 cm)", and "TSKgel, SuperHZ2000 (manufactured by TOSOH CORPORATION, 4.6 mmID x 15 cm)" were used.

[0043] For example, the following conditions can be adopted as the conditions of GPC.

- Eluant Tetrahydrofuran (THF)
- Flow Rate 0.35 ml/min
- Measurement Temperature 40°C (Column, Inlet, RI)
- Analysis Time 20 minutes
- Sample Concentration 0.1%
- Sample Injection Amount 10 μ l

[0044] The composite ester A may contain an unreacted c1 component. The content of the unreacted c1 component with respect to the total amount of the composite ester A is preferably less than or equal to 10%, is more preferably less than or equal to 6%, and is particularly preferably less than or equal to 4%. In the GPC measurement described above, the content of the unreacted c1 component can be calculate by using an area ratio of a molecular weight peak corresponding to c1.

[0045] A kinematic viscosity of the composite ester A at 40°C is preferably 400 to 2,000 mm²/s, is more preferably 500 to 2,000 mm²/s, is even more preferably 500 to 1,500 mm²/s, is still more preferably 600 to 1,200 mm²/s, and is

particularly preferably 700 to 1,100 mm²/s. Specifically, a value measured in a thermostatic water tank at 40.0°C by using an UBBELOHDE VISCOSIMETER is adopted as the kinematic viscosity at 40°C. By setting the viscosity of the composite ester A to be in a specific region, it is possible to suppress abrasion while maintaining a low viscosity of the lubricant composition.

[0046] An acid value of the composite ester A (the number of mg of KOH required for neutralizing 1 g of a sample) is preferably 0 to 50 mgKOH/g, is more preferably 0 to 15 mgKOH/g, and is even more preferably 2 to 10 mgKOH/g. Specifically, the acid value of the composite ester A (the number of mg of KOH required for neutralizing 1 g of a sample) is a value measured according to a JISK2501 method.

(Manufacturing Method of Composite Ester A)

[0047] The composite ester A can be obtained by feeding the a1 component to the c1 component such that a ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of c1 becomes 1/1.5 to 2.0/0.7 to 1.5, preferably becomes 1/1.55 to 1.9/0.8 to 1.4, and more preferably becomes 1/1.60 to 1.8/0.8 to 1.3, and by performing a condensation reaction with respect to the a1 component to the c1 component.

[0048] A mixture fed as described above is subjected to the condensation reaction in the presence of a catalyst or a condensation agent or in the absence of a catalyst, and thus, the composite ester A can be obtained.

[0049] In a case where the condensation is performed, it is desirable that heating is performed or a solvent azeotropic with water or low molecular alcohol exists in a suitable amount. Accordingly, the reaction is also performed smoothly without coloring the composite ester A. The solvent is preferably a hydrocarbon-based solvent having a boiling point of 100°C to 200°C, is more preferably a hydrocarbon-based solvent having a boiling point of 100°C to 170°C, and is most preferably a hydrocarbon-based solvent having a boiling point of 110°C to 160°C. Examples of the solvent include toluene, xylene, mesitylene, and the like. In a case where the amount of the solvent to be added is excessively large, a liquid temperature is in the vicinity of the temperature of the solvent, and the condensation is rarely performed. In contrast, in a case where the amount of the solvent to be added is excessively small, azeotropy is not smoothly performed. It is preferable that the condensation reaction is performed without using the solvent from the viewpoint of productivity.

[0050] The reaction is accelerated by using the catalyst, but a post treatment of removing the catalyst is complicated, and thus, it is desirable that the catalyst is not used since the catalyst causes coloration of the composite ester A. However, in a case where the catalyst is used, general conditions and a general operation are used in a general catalyst. This can be referred to references such as JP2001-501989A, JP2001-500549A, JP2001-507334A, and JP2002-509563A.

[0051] After the feeding ends, the reaction is performed at a liquid temperature of 120°C to 250°C, preferably at a liquid temperature of 130°C to 240°C, more preferably at a liquid temperature of 150°C to 230°C, and particularly preferably at a liquid temperature of 170°C to 230°C. Accordingly, a solvent containing water or low molecular alcohol is azeotropic, is cooled in a cooling position, and becomes a liquid, and thus, is separated. The water may be removed. After the reaction is performed at a low temperature, the reaction may be further performed at a high temperature.

[0052] In a reaction time, the amount of theoretically generated water is calculated by the number of moles of the feeding, and thus, it is preferable that the reaction is performed until a time point at which the amount of water is obtained, but it is difficult to completely end the reaction. Even in a case where the reaction ends at a time point at which the amount of theoretically generated water is 60% to 99%, the lubrication properties of the lubricant composition containing the obtained composite ester A are excellent. The reaction time is 1 to 24 hours, is preferably 3 to 20 hours, is more preferably 5 to 18 hours, and is most preferably 6 to 15 hours.

[0053] Performing the reaction at 170°C to 200°C for 1 to 10 hours (preferably, 2 to 8 hours) in the absence of a solvent and a catalyst, and then, further performing the reaction at 201°C to 240°C for 1 to 10 hours (preferably, 2 to 8 hours) are preferable as more preferred reaction conditions.

(Other Components other than Composite Ester A of Lubricant Composition)

[0054] The present invention relates to the lubricant composition containing at least the composite ester A. For example, the composite ester A and various additives and/or various mediums can be added to the lubricant composition.

[0055] It is preferable that the lubricant composition of the present invention further contains a medium, contains 0.1 to 5 mass% of the composite ester A and 70 to 99.9 mass% of the medium with respect to the total mass of the lubricant composition, and contains 0 to 29.9 mass% of the other components other than the composite ester A and the medium with respect to the total mass of the lubricant composition.

[0056] An increase rate (%) of the kinematic viscosity according to addition of the composite ester A can be calculated by the following relational expression. In the following relational expression, NA represents kinematic viscosities of only the medium and the other components at 40°C to which the composite ester A is not added, and NB represents the

kinematic viscosities of the medium and the other components at 40°C at the time of adding the composite ester A.

$$\text{Kinematic Viscosity Increase Rate (\%)} = \{[(NB) - (NA)] / (NA)\} \times 100$$

[0057] The increase rate (%) of the kinematic viscosity is preferably less than or equal to 15%, is more preferably less than or equal to 10%, is even more preferably less than or equal to 5%, is particularly preferably less than or equal to 2%, and is most preferably less than or equal to 1.5%. It is preferable that the composite ester A is added such that the kinematic viscosity increase rate is in the range described above, and thus, the lubricant composition of the present invention is prepared.

(Medium)

[0058] Examples of the medium (also referred to as base oil) can include one type or two or more types selected from mineral oil, a fatty oil compound, polyolefin oil (for example, poly alpha olefin), silicone oil, ether oil (for example, perfluoropolyether oil and a diphenyl ether derivative), and ester oil (for example, aromatic ester oil, monovalent fatty acid ester, divalent fatty acid diester, and polyol ester lubricating oil). Among them, at least one type selected from the mineral oil, the polyolefin oil, and the ester oil is preferable as the medium.

[0059] In the present invention, the "medium" indicates all mediums which are generally referred to as a "fluidic liquid". Here, it is not necessary that the medium is in a liquid state at room temperature or at a temperature to be used, but a material in any state such as a solid and a gel other than the liquid can be used. The medium which can be used in the present invention is not particularly limited, and can be selected from various liquids according to the application. The medium which can be used in the present invention can be referred to the description in paragraphs 0067 to 0096 of JP2011-89106A. The kinematic viscosity of the medium at 40°C is preferably 1 to 500 mm²/s, is more preferably 1.5 to 200 mm²/s, and is even more preferably 2 to 50 mm²/s.

[0060] The viscosity index of the medium is preferably greater than or equal to 90, is more preferably greater than or equal to 105, and is even more preferably greater than or equal to 110. In addition, it is preferable that the viscosity index of the medium is less than or equal to 160. By setting the viscosity index to be in the range described above, viscosity-temperature properties, heat and oxidation stability, and volatilization inhibiting properties become excellent, and abrasion inhibiting properties are improved.

[0061] Furthermore, the viscosity index in the present invention indicates a viscosity index measured on the basis of JIS K 2283-1993.

(Other Components other than Composite Ester A and Medium)

[0062] A preferred compound as the other components other than the composite ester A and the medium, that is, a preferred additive with respect to the lubricant composition of the present invention is a compound having at least one type of zinc, molybdenum, sulfur, or phosphorus as a constituent element. Such a compound has a function of a friction adjusting agent, an abrasion inhibiting agent, an antioxidant, and the like. The compound containing at least one type of zinc, molybdenum, sulfur, or phosphorus as a constituent element indicates a compound which may contain zinc, molybdenum, sulfur, and phosphorus in the compound in any state. Specifically, examples of the compound can include a compound containing zinc, molybdenum, sulfur, and phosphorus as a single body (the oxidation number of 0), an ion, a complex, and the like. Examples of such a compound include an organic molybdenum compound, an inorganic molybdenum compound, an organic zinc compound, a phosphoric acid derivative, an organic sulfur compound, and the like. Among them, the organic molybdenum compound and the organic zinc compound are preferable.

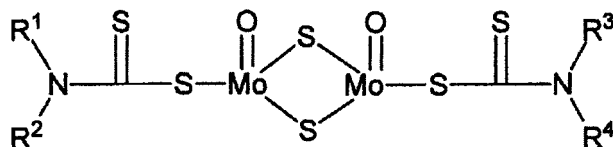
[0063] Only one type of the compound containing at least one type of zinc, molybdenum, sulfur, or phosphorus as a constituent element may be added to the lubricant composition of the present invention, or a combination of two or more types of the compounds may be added to the lubricant composition of the present invention. In a case where the combination of two or more types of the compounds containing at least one type of zinc, molybdenum, sulfur, or phosphorus as the constituent element is added to the lubricant composition of the present invention, it is preferable that two or more types of the organic molybdenum compound, the inorganic molybdenum compound, the organic zinc compound, the phosphoric acid derivative, and the organic sulfur compound are combined, and it is more preferable that the organic molybdenum compound and the organic zinc compound are combined.

[0064] Hereinafter, a preferred aspect of each of the organic molybdenum compound, the inorganic molybdenum compound, and the organic zinc compound, the phosphoric acid derivative, and the organic sulfur compound will be described.

[0065] Examples of the organic molybdenum compound which is used in the lubricant composition as an additive can

include an organic molybdenum compound containing phosphorus, such as molybdenum dithiophosphate (also referred to as MoDTP).

[0066] Examples of another organic molybdenum compound can include an organic molybdenum compound containing sulfur, such as molybdenum dithiocarbamate represented by the following formula (also referred to as MoDTC). For example, oxy molybdenum-N,N-di-octyl dithiocarbamate sulfide ($C_8\text{-Mo(DTC)}$), oxy molybdenum-N,N-di-tridecyl dithiocarbamate sulfide ($C_{16}\text{-Mo(DTC)}$), and the like are preferable as the organic molybdenum compound containing sulfur.



[0067] In the following formulas, R^1 to R^4 may be identical to each other or different from each other, and each independently represent a hydrocarbon group. It is preferable that R^1 to R^4 are each independently an alkyl group or an aryl group.

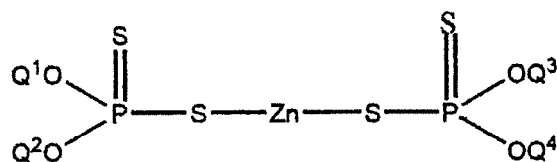
[0068] Examples of another organic molybdenum compound containing sulfur can include a complex between an inorganic molybdenum compound and a sulfur-containing organic compound. Examples of the inorganic molybdenum compound to be used in the organic molybdenum compound which is the complex between the inorganic molybdenum compound and the sulfur-containing organic compound can include molybdenum oxide molybdenum oxide such as molybdenum dioxide and molybdenum trioxide, a molybdic acid such as an orthomolybdic acid, a paramolybdic acid, and (poly)molybdic sulfide, a molybdate such as a metal salt and an ammonium salt of the molybdic acids, molybdenum sulfide such as molybdenum disulfide, molybdenum trisulfide, molybdenum pentasulfide, and polymolybdenum sulfide, molybdic sulfide, a metal salt or an amine salt of the molybdic sulfide, molybdenum halide such as molybdenum chloride, and the like. In addition, examples of the sulfur-containing organic compound to be used in the organic molybdenum compound which is the complex between the inorganic molybdenum compound and the sulfur-containing organic compound can include alkyl (thio)xanthate, thiadiazole, mercaptothiadiazole, thiocarbonate, tetrahydrocarbyl thiuram disulfide, bis(di(thio)hydrocarbyl dithiophosphonate)disulfide, organic (poly)sulfide, ester sulfide, and the like.

[0069] Examples of another organic molybdenum compound containing sulfur can include a complex between a sulfur-containing molybdenum compound such as molybdenum sulfide and molybdic sulfide and alkenyl succinic acid imide.

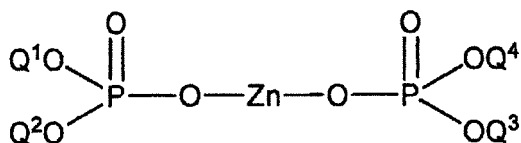
[0070] An organic molybdenum compound which does not contain phosphorus or sulfur as a constituent element can be used as the organic molybdenum compound. Specifically, examples of the organic molybdenum compound which does not contain phosphorus or sulfur as a constituent element include a molybdenum-amine complex, a molybdenum-succinic acid imide complex, a molybdenum salt of an organic acid, a molybdenum salt of alcohol, and the like, and among them, the molybdenum-amine complex, the molybdenum salt of the organic acid, and the molybdenum salt of the alcohol are preferable.

[0071] Examples of the inorganic molybdenum compound which is used in the lubricant composition as an additive are identical to the examples of the inorganic molybdenum compound to be used in the organic molybdenum compound which is the complex between the inorganic molybdenum compound and the sulfur-containing organic compound.

[0072] Zinc dithiophosphate (ZDTP) and zinc diphosphate (ZDP) represented by the following formulas are preferable as the organic zinc compound which is used in the lubricant composition as the additive.



Z D T P



Z D P

[0073] In the formula described above, Q^1 , Q^2 , Q^3 , and Q^4 may be identical to each other or different from each other, and each independently represent an alkyl group having 8 to 20 carbon atoms such as an isopropyl group, a butyl group,

an isobutyl group, a pentyl group, an isopentyl group, a neopentyl group, a hexyl group, a heptyl group, an octyl group, a 2-ethyl hexyl group, a nonyl group, a decyl group, an undecyl group, a dodecyl group, a tridecyl group, an isotridecyl group, a myristyl group, a palmityl group, and a stearyl group.

[0074] Specifically, zinc n-butyl-n-pentyl dithiophosphoric acid (C_4/C_5 ZnDTP), zinc di-2-ethyl hexyl dithiophosphoric acid (C_8 ZnDTP), or zinc isopropyl-1-ethyl butyl dithiophosphoric acid (C_3/C_6 ZnDTP) are preferable as the zinc dithiophosphate (ZDTP) represented by the formula described above.

[0075] In the lubricant composition of the present invention, in a case where the organic molybdenum compound is used, the organic molybdenum compound is contained such that the content of molybdenum is preferably 10 to 2,000 ppm, is more preferably 10 to 1,000 ppm, is even more preferably 50 to 800 ppm, and is particularly preferably 100 to 600 ppm, with respect to the total mass of the lubricant composition.

[0076] In addition, in a case where the organic zinc compound is used, the organic zinc compound is contained such that the content of zinc is preferably 100 to 50,000 ppm, is more preferably 100 to 30,000 ppm, is even more preferably 100 to 10,000 ppm, is particularly preferably 200 to 2,000 ppm, and is most preferably 300 to 1,200 ppm, with respect to the total mass of the lubricant composition.

[0077] By setting the content of the organic metal compound such as the organic molybdenum compound or the organic zinc compound in the lubricant composition to be in the range described above, it is possible to increase stability of the lubricant composition, it is possible to improve lubrication properties in rigorous conditions such as a high temperature and/or a high pressure, and it is possible to exhibit more excellent lubrication performance and abrasion suppression performance.

[0078] The zinc dithiophosphate (ZDTP) described above, phosphorus acid esters other than the zinc diphosphate (ZDP), phosphoric acid esters, aromatic phosphoric acid ester such as tricresyl phosphate, and aliphatic phosphoric acid ester such as trialkyl phosphate can be exemplified as a preferred example of the phosphoric acid derivative. Among them, the aromatic phosphoric acid ester such as tricresyl phosphate, the aliphatic phosphoric acid ester such as trialkyl phosphate, and the like are more preferable.

[0079] Polysulfides is preferable as the organic sulfur compound, and dialkyl polysulfide is more preferable.

[0080] In addition to the compounds described above, examples of the other components other than the composite ester A and the medium can include one type or two or more types selected from a viscosity index improving agent (preferably, polyalkyl (meth)acrylate, and a (meth)acrylate copolymer having an alkyl (meth)acrylate-polar group, butadiene, olefin, or a polymer and a copolymer of alkylated styrene), an antioxidant (preferably, a hindered phenol compound, a sulfurized alkyl phenol compound, an aromatic amine compound, a low-sulfur peroxide decomposition agent, and an oil-soluble copper compound), a detergent (sulfate, phenate, carboxylate, phosphate, an alkali metal salt or an alkali earth metal salt of salicylate, (boric acid-modified) succinic acid imide, and succinic acid ester), a dispersant (preferably, phenate, sulfonate, sulfurized phenate, salicylate, naphthenate, stearate, carbamate, thiocarbamate, a phosphorous derivative, a succinic acid derivative (for example, a long-chain substituted alkenyl succinic acid derivative, a succinic acid imide derivative, a hydrocarbyl-substituted succinic acid compound, succinic acid ester, and succinic acid ester amide), a MANNICH base), a pour point lowering agent (preferably, polymethacrylate, polyacrylate, polyaryl amide, a condensation product of haloparaffin wax and an aromatic compound, a vinyl carboxylate polymer, dialkyl fumarate, vinyl ester of a fatty acid, and a terpolymer of allyl vinyl ether), a corrosion inhibiting agent (preferably, thiadiazole), a sealing compliance agent (preferably, organic phosphate, aromatic ester, aromatic hydrocarbon, ester (for example, butyl benzyl phthalate), and a polybutenyl succinic anhydride), an anti-foaming agent (preferably, polydimethyl silicone), a rust inhibiting agent, a friction adjusting agent, an abrasion inhibiting agent, and a thickener.

[0081] By adding such an additive, it is possible to provide a function such as abrasion suppression, which is preferable as a lubricant composition. The additive which can be used in the present invention can be referred to the description in paragraphs 0098 to 0165 of JP2011-89106A.

(Properties of Lubricant Composition)

[0082] The kinematic viscosity of the lubricant composition of the present invention at 40°C is preferably less than or equal to 500 mm²/s, is more preferably less than or equal to 200 mm²/s, is even more preferably less than or equal to 100 mm²/s, is particularly preferably less than or equal to 50 mm²/s, and is most preferably 5 to 50 mm²/s. A suitable viscosity is required according to the use environment, and thus, it is necessary that the viscosity is in the range described above. Herein, specifically, a value measured in a thermostatic water tank at 40.0°C by using an UBBELOHDE viscosimeter is adopted as the kinematic viscosity of the lubricant composition at 40°C.

(Manufacturing Method of Lubricant Composition)

[0083] The present invention relates to a manufacturing method of a lubricant composition including a step of obtaining composite ester A, in which the concentration of the composite ester A is 0.1 to 5 mass%, and relates to a lubricant

composition manufactured by such a manufacturing method. The step of obtaining the composite ester A is a step of mixing and condensing at least trivalent or more polyol a1, a mixture b1 of at least one of a polymerization reaction mixture of an unsaturated fatty acid having 18 to 22 carbon atoms which contains at least 75 mass% of a divalent carboxylic acid having 36 to 44 carbon atoms or a mixture obtained by performing hydrogenation with respect to the polymerization reaction mixture, and monool c1 represented by General Formula (1) described below such that the number of moles of a hydroxyl group of a1/the number of moles of a carboxylic acid of b1/the number of moles of a hydroxyl group of c1 becomes 1/1.5 to 2.0/0.7 to 1.5.

General Formula (1): $R-OH$

[0084] In General Formula (1), R represents a linear alkyl group having greater than or equal to 8 carbon atoms or a branched alkyl group having greater than or equal to 8 carbon atoms.

[0085] In a mixed ratio of an a1 component to a c1 component, the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of c1 may be 1/1.5 to 2.0/0.7 to 1.5, is preferably 1/1.55 to 1.9/0.8 to 1.4, and is more preferably 1/1.60 to 1.8/0.8 to 1.3.

[0086] The lubricant composition of the present invention can be prepared by adding the composite ester A into an oleaginous medium or an aqueous medium such that the concentration becomes 0.1 to 5 mass%, and by performing dissolution and/or dispersion with respect to the composite ester A. The dissolution and/or dispersion may be performed under heating.

[0087] The lubricant composition of the present invention may be prepared as a grease composition. In this aspect, in order to ensure practical performance in a case of being adapted for application of grease, and as necessary, a thickener or the like can be suitably added in a range not impairing the object of the present invention. An aspect of the grease composition is a composition further containing 10 to 50 mass% of a thickener. Hereinafter, an additive which can be added at the time of being prepared as the grease composition will be described.

[0088] Any thickener, for example, a soap-based thickener such as metal soap and composite metal soap, a non-soap-based thickener such as BENTON, silica gel, and a urea-based thickener (a urea compound, a urea and urethane compound, a urethane compound, and the like), and the like can be used as an example of a thickener which can be added. Among them, the soap-based thickener and the urea-based thickener are preferably used since such thickeners rarely impair a resin member.

[0089] Examples of the soap-based thickener include sodium soap, calcium soap, aluminum soap, lithium soap, and the like, and among them, the lithium soap is preferable from the viewpoint of water resistance or heat stability. Examples of the lithium soap include lithium stearate, lithium-12-hydroxy stearate, or the like.

[0090] In addition, examples of the urea-based thickener include a urea compound, a urea and urethane compound, a urethane compound, or a mixture thereof, and the like.

[0091] Examples of the urea compound, the urea and urethane compound, and the urethane compound include a diurea compound, a triurea compound, a tetraurea compound, a polyurea compound (excluding a diurea compound, a triurea compound, and a tetraurea compound), a urea and urethane compound, a diurethane compound, or a mixture thereof, and the like. The diurea compound, the urea and urethane compound, the diurethane compound, or the mixture thereof are preferable.

[0092] Examples of a solid lubricant include polytetrafluoroethylene, boron nitride, fullerene, black lead, graphite fluoride, melamine cyanurate, molybdenum disulfide, Mo-dithiocarbamate, antimony sulfide, an alkali (earth) metal borate, and the like.

[0093] Various waxes such as natural wax, mineral oil-based wax, or synthesis-based wax can be exemplified as an example of wax, and specifically, examples of the wax include montan wax, carnauba wax, an amide compound of a higher fatty acid, paraffin wax, microcrystalline wax, polyethylene wax, polyolefin wax, ester wax, and the like.

[0094] In addition, benzotriazole, benzimidazole, thiadiazole, and the like are known as a metal deactivator, and can be added.

[0095] The thickener can be added to the grease composition. Examples of the thickener include polymethacrylate, polyisobutylene, polystyrene, and the like. It is known that the poly(meth)acrylate also has an effect of preventing abnormal noise at a low temperature in a cold region.

(Application of Lubricant Composition)

[0096] The lubricant composition of the present invention, for example, can be used for reducing friction by being supplied to a space between two sliding surfaces. The lubricant composition of the present invention can form a film on the sliding surface. Specifically, examples of the material of the sliding surface include carbon steel for a mechanical structure, alloy steel for a mechanical structure such as a nickel chromium steel material, a nickel chromium molybdenum steel material, a chromium steel material, a chromium molybdenum steel material, and an aluminum chromium molyb-

denum steel material, stainless steel, maraging steel, and the like, in steel.

[0097] Various metals other than steel, or inorganic materials or organic materials other than metal are also widely used as the material of the sliding surface. Examples of the inorganic material or the organic material other than metal include various plastics, ceramics, carbons, a mixed body thereof, and the like. More specifically, examples of the metal material other than steel include cast iron, a copper-copper-lead-aluminum alloy, casting thereof, and white metal.

[0098] Furthermore, the material of the sliding surface can be referred to the description in paragraphs 0168 to 0175 of JP2011-89106A.

[0099] The lubricant composition of the present invention can be used in various applications. For example, the lubricant composition of the present invention can be used as lubricating oil for grease, a releasing agent, oil for an internal combustion engine, engine oil for an internal combustion engine, oil for metal working (cutting), bearing oil, fuel for a combustion engine, vehicle engine oil, gear oil, operating oil for an automobile, lubricating oil for a vessel and an aircraft, machine oil, turbine oil, hydraulic operating oil, compressor and vacuum pump oil, freezer oil, a lubricating oil agent for metal working, a lubricant for a magnetic recording medium, a lubricant for a micro machine, a lubricant for an artificial bone, shock absorber oil, or rolling oil. Further, the lubricant composition of the present invention is also used in an air conditioner or a refrigerator including a reciprocating type airtight compressor or a rotating type airtight compressor, an air conditioner or a dehumidifier for an automobile, a cooling device of a freezer, a freezing refrigerating warehouse, a vending machine, a showcase, and a chemical plant, and the like.

[0100] The lubricant composition of the present invention is useful as a lubricating oil agent for metal working which does not contain a chlorine-based compound, for example, when a metal material such as an iron and steel material or an A1 alloy is subjected to hot rolling, or is subjected to working such as cutting, and is useful as metal working oil or metal plastic working oil such as cold rolling oil, cutting oil, grinding oil, drawing oil, and press working oil of aluminum, and in particular, is useful as an inhibitor against abrasion, damage, and surface roughness at the time of performing high-speed and high-load working, and is also useful as a metal working oil composition which can be applied to low-speed heavy cutting such as broach working and gun drill working.

[0101] In addition, the lubricant composition of the present invention can be used in various lubricating oils for grease, a lubricant for a magnetic recording medium, a lubricant for a micro machine, a lubricant for an artificial bone, and the like. In addition, it is possible to configure the element composition of the composition as a carbohydrate, and thus, for example, a composition in which sorbitan fatty acid ester containing polyoxy ethylene ether and edible oil are contained as base oil, which is widely used in cake mix, salad dressing, shortening oil, chocolate, and the like as an emulsifier, a dispersant, and a solubilizer, is used as lubricating oil, and therefore, high-performance lubricating oil which is entirely harmless to a human body can be used in the lubrication of a manufacturing device in a food manufacturing line or a medical instrument member.

[0102] Further, the lubricant composition of the present invention is dispersed by being emulsified in water system or is dispersed in a polar solvent or a resin medium, and thus, can be used as cutting oil or rolling oil.

[0103] In addition, the lubricant composition of the present invention can also be used as a releasing agent in various applications. For example, the lubricant composition of the present invention is used as a releasing agent of a polycarbonate resin, a flame retardant polycarbonate resin, a crystalline polyester resin which is a main component of a toner for forming an image used in an electrophotographic device, an electrostatic recording device, or the like, a thermoplastic resin composition for various moldings, an epoxy resin composition for sealing a semiconductor, and the like.

[0104] In addition, the lubricant composition of the present invention is kneaded into or is applied onto a fiber product of a clothing material or the like in advance, and thus, can be used as a stain-proofing agent which accelerates removal of stain attached onto the fiber product and prevents the fiber product from being stained.

Examples

[0105] Hereinafter, the characteristics of the present invention will be more specifically described with reference to examples and comparative examples. Materials, used amounts, ratios, treatment contents, treatment sequences, and the like of the following examples can be suitably changed unless the changes cause deviance from the gist of the present invention. Accordingly, the range of the present invention will not be restrictively interpreted by the following specific examples.

<Synthesis of Composite Ester A-1>

[0106] 9.38 g of trimethylol propane as the a1 component, 100.0 g of a dimer acid (TSUNODYME 395 manufactured by TSUNO CO., LTD., a content ratio of a dicarboxylic acid having 36 carbon atoms of 95%) as the b1 component, and 50.6 g of 2-hexyl-1-decanol (FINEOXOCOL 1600 manufactured by Nissan Chemical Industries, Ltd.) as the c1 component (Ratio of Number of Moles of Hydroxyl Group of a1/Number of Moles of Carboxylic Acid of b1/Number of Moles of Hydroxyl Group of Monool = 1/1.7/1) were fed into a reaction vessel provided with a DEAN-STARK DEHYDRATION

DEVICE. The mixture of the a1 component to the c1 component was subjected to a reaction at 190°C for 5 hours, and at 220°C for 4 hours under nitrogen stream of 0.3 L/min. Water generated during the reaction was removed. A reactant was left to cool to room temperature, and thus, composite ester A-1 was obtained as a yellow transparent liquid substance.

<Synthesis of Composite Ester A-2>

[0107] Trimethylol propane as the a1 component, a dimer acid (TSUNODYME 228 manufactured by TSUNO CO., LTD., a content ratio of a dicarboxylic acid having 36 carbon atoms of 81%) as the b1 component, and 2-hexyl-1-decanol (FINEOXOCOL 1600 manufactured by Nissan Chemical Industries, Ltd.) as the c1 component were fed such that the ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of the monool became 1/1.7/1. The mixture was condensed by using the same method as that in the synthesis of A-1, and thus, composite ester A-2 was obtained.

<Synthesis of Composite Ester A-3>

[0108] Trimethylol propane as the a1 component, a dimer acid (TSUNODYME 216 manufactured by TSUNO CO., LTD., a content ratio of a dicarboxylic acid having 36 carbon atoms of 79%) as the b1 component, and 2-hexyl-1-decanol (FINEOXOCOL 1600 manufactured by Nissan Chemical Industries, Ltd.) as the c1 component were fed such that the ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of the monool became 1/1.7/1. The mixture was condensed by using the same method as that in the synthesis of A-1, and thus, composite ester A-3 was obtained.

<Synthesis of Composite Ester A-4>

[0109] Trimethylol propane as the a1 component, a hydrogenated dimer acid (PRIPOL 1009 manufactured by Croda International P1c, a content ratio of a dicarboxylic acid having 36 carbon atoms of 98%) as the b1 component, and 2-hexyl-1-decanol (FINEOXOCOL 1600 manufactured by Nissan Chemical Industries, Ltd.) as the c1 component were fed such that the ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of the monool became 1/1.7/1. The mixture was condensed by using the same method as that in the synthesis of A-1, and thus, composite ester A-4 was obtained.

<Synthesis of Composite Ester A-5>

[0110] Trimethylol propane as the a1 component, a polymeric substance containing a dicarboxylic acid having 44 carbon atoms as a main component (PRIPOL 1004 manufactured by Croda International P1c, a content ratio of a dicarboxylic acid having 44 carbon atoms of 95%) as the b1 component, and 2-hexyl-1-decanol (FINEOXOCOL 1600 manufactured by Nissan Chemical Industries, Ltd.) as the c1 component were fed such that the ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of the monool became 1/1.7/1. The mixture was condensed by using the same method as that in the synthesis of A-1, and thus, composite ester A-5 was obtained.

<Synthesis of Composite Ester A-6>

[0111] Trimethylol propane as the a1 component, a dimer acid (TSUNODYME 395 manufactured by TSUNO CO., LTD., a content ratio of a dicarboxylic acid having 36 carbon atoms of 95%) as the b1 component, and 2-ethyl hexanol as the c1 component were fed such that the ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of the monool became 1/1.7/1. The mixture was condensed by using the same method as that in the synthesis of A-1, and thus, composite ester A-6 was obtained.

<Synthesis of Composite Ester A-7>

[0112] Trimethylol propane as the a1 component, a polymeric substance containing a dicarboxylic acid having 44 carbon atoms as a main component (PRIPOL 1004 manufactured by Croda International P1c, a content ratio of a dicarboxylic acid having 44 carbon atoms of 95%) as the b1 component, and 2-ethyl hexanol as the c1 component were fed such that the ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of the monool became 1/1.7/1. The mixture was condensed by using the same method as that in the synthesis of A-1, and thus, composite ester A-7 was obtained.

<Synthesis of Composite Ester A-8>

[0113] Trimethylol propane as the a1 component, a dimer acid (TSUNODYME 395 manufactured by TSUNO CO., LTD., a content ratio of a dicarboxylic acid having 36 carbon atoms of 95%) as the b1 component, and 2-ethyl hexanol as the c1 component were fed such that the ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of the monool became 1/1.5/0.75. The mixture was condensed by using the same method as that in the synthesis of A-1, and thus, composite ester A-8 was obtained.

<Synthesis of Composite Ester A-9>

[0114] Trimethylol propane as the a1 component, a dimer acid (TSUNODYME 395 manufactured by TSUNO CO., LTD., a content ratio of a dicarboxylic acid having 36 carbon atoms of 95%) as the b1 component, and 2-ethyl hexanol as the c1 component were fed such that the ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of the monool became 1/2.0/1.33. The mixture was condensed by using the same method as that in the synthesis of A-1, and thus, composite ester A-9 was obtained.

<Synthesis of Composite Ester A-10>

[0115] Trimethylol propane as the a1 component, a dimer acid (TSUNODYME 395 manufactured by TSUNO CO., LTD., a content ratio of a dicarboxylic acid having 36 carbon atoms of 95%) as the b1 component, and 2-hexyl-1-decanol (FINEOXOCOL 1600 manufactured by Nissan Chemical Industries, Ltd.) as the c1 component were fed such that the ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of the monool became 1/1.57/1. The mixture was condensed by using the same method as that in the synthesis of A-1, and thus, composite ester A-10 was obtained.

<Synthesis of Composite Ester-11>

[0116] Trimethylol propane as the a1 component, a dimer acid (TSUNODYME 395 manufactured by TSUNO CO., LTD., a content ratio of a dicarboxylic acid having 36 carbon atoms of 95%) as the b1 component, and 2-hexyl-1-decanol (FINEOXOCOL 1600 manufactured by Nissan Chemical Industries, Ltd.) as the c1 component were fed such that the ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of the monool became 1/2.0/1. The mixture was condensed by using the same method as that in the synthesis of A-1, and thus, composite ester A-11 was obtained.

<Synthesis of Composite Ester A-12>

[0117] Trimethylol propane as the a1 component, a dimer acid (TSUNODYME 395 manufactured by TSUNO CO., LTD., a content ratio of a dicarboxylic acid having 36 carbon atoms of 95%) as the b1 component, and 2-hexyl-1-decanol (FINEOXOCOL 1600 manufactured by Nissan Chemical Industries, Ltd.) as the c1 component were fed such that the ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of the monool became 1/1.85/1. The mixture was condensed by using the same method as that in the synthesis of A-1, and thus, composite ester A-12 was obtained.

<Synthesis of Composite Ester A-13>

[0118] Trimethylol propane as the a1 component, a dimer acid (TSUNODYME 395 manufactured by TSUNO CO., LTD., a content ratio of a dicarboxylic acid having 36 carbon atoms of 95%) as the b1 component, monoalcohol having a branched alkyl group having 18 carbon atoms (FINEOXOCOL 180N manufactured by Nissan Chemical Industries, Ltd.) as the c1 component were fed such that the ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of the monool became 1/1.7/1. The mixture was condensed by using the same method as that in the synthesis of A-1, and thus, composite ester A-13 was obtained.

<Synthesis of Composite Ester A-14>

[0119] Trimethylol propane as the a1 component, a dimer acid (TSUNODYME 395 manufactured by TSUNO CO.,

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LTD., a content ratio of a dicarboxylic acid having 36 carbon atoms of 95%) as the b1 component, n-octadecanol as the c1 component were fed such that the ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of the monool became 1/1.7/1. The mixture was condensed by using the same method as that in the synthesis of A-1, and thus, composite ester A-14 was obtained.

[0120] The compositions of the composite esters A-1 to A-14 are as shown in Table 1. In addition, each of the components is as follows.

<a1 Component>

TMP: Trimethylol Propane
PE: Pentaerythritol

<b1 Component>

C36-1: TSUNODYME 395 manufactured by TSUNO CO., LTD., a content ratio of a dicarboxylic acid having 36 carbon atoms of 95%
C36-2: TSUNODYME 228 manufactured by TSUNO CO., LTD., a content ratio of a dicarboxylic acid having 36 carbon atoms of 81 %
C36-3: TSUNODYME 216 manufactured by TSUNO CO., LTD., a content ratio of a dicarboxylic acid having 36 carbon atoms of 79%
C36-4: Hydrogenated Dimer Acid (PRIPOL 1009 manufactured by Croda International P1c, a content ratio of a dicarboxylic acid having 36 carbon atoms of 98%)
C44-1: Polymeric Substance Containing Dicarboxylic Acid Having 44 Carbon Atoms as Main Component (PRIPOL 1004 manufactured by Croda International P1c, a content ratio of a dicarboxylic acid having 44 carbon atoms of 95%)

<c1 Component>

EH8B: 2-Ethyl Hexanol
HD16B: 2-Hexyl-1-Decanol (FINEOXOCOL 1600 manufactured by Nissan Chemical Industries, Ltd.)
OD18B: Monoalcohol Having Branched Alkyl Group Having 18 Carbon Atoms (FINEOXOCOL 180N manufactured by Nissan Chemical Industries, Ltd.)
OD18N: n-Octadecanol
DD20B: Monoalcohol Having Branched Alkyl Group Having 20 Carbon Atoms (FINEOXOCOL 2000 manufactured by Nissan Chemical Industries, Ltd.)

[Table 1]

Composite Ester A	a1		b1		c1		Mol of Hydroxyl Group of al/Mol of Carboxylic Acid of b1/Mol of Hydroxyl Group of c1	Total Mol of Hydroxyl Group/Total Mol of Carboxylic Acid	Kinematic Viscosity at 40°C mm ² /s	Acid Value mgKOH/g	Monool Residue
	Type	Molar Ratio	Type	Molar Ratio	Type	Molar Ratio					
A-1	TMP	1	C36-1	2.56	HD16B	3	1/1.7/1	1/0.86	762	6.2	<3%
A-2	TMP	1	C36-2	2.56	HD16B	3	1/1.7/1	1/0.86	802	6.5	<3%
A-3	TMP	1	C36-3	2.56	HD16B	3	1/1.7/1	1/0.86	786	7	<3%
A-4	TMP	1	C36-4	2.56	HD16B	3	1/1.7/1	1/0.86	748	7.3	<3%
A-5	TMP	1	C44-1	2.56	HD16B	3	1/1.7/1	1/0.86	928	6	<3%
A-6	TMP	1	C36-1	2.56	EH8B	3	1/1.7/1	1/0.86	998	5.8	<3%
A-7	TMP	1	C44-1	2.56	EH8B	3	1/1.7/1	1/0.86	1,150	6	<3%
A-8	TMP	1	C36-1	2.26	EH8B	2.26	1/1.5/0.75	1/0.86	1,490	4.9	<3%
A-9	TMP	1	C36-1	3	EH8B	4	1/2.0/1.33	1/0.86	560	7.9	<3%
A-10	TMP	1	C36-1	2.35	HD16B	3	1/1.57/1	1/0.78	680	4.9	8%
A-11	TMP	1	C36-1	3	HD16B	3	1/2.0/1	1/1.0	1,020	16.6	4%
A-12	TMP	1	C36-1	2.78	HD16B	3.48	1/1.85/1	1/0.86	620	6.8	<3%
A-13	TMP	1	C36-1	2.56	OD18B	3	1/1.7/1	1/0.86	794	6.2	<3%
A-14	TMP	1	C36-1	2.56	OD18N	3	1/1.7/1	1/0.86	860	4.9	<3%
A-15	PE	1	C36-1	3.5	HD16B	4	1/1.75/1	1/0.88	1,950	7.5	<3%
A-16	PE	1	C44-1	3.5	DD20B	4	1/1.75/1	1/0.88	2,700	8.3	<3%

<Synthesis of Composite Ester X-1 for Comparison>

[0121] In the synthesis of the composite ester A-1, 20 mol% of the dimer acid was substituted with an adipic acid, and the components were fed such that the ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of the monool became 1/1.4/1. The mixture was condensed by using the same method as that in the synthesis of the composite ester A-1, and thus, composite ester X-1 for comparison was obtained.

<Synthesis of Composite Ester X-2 for Comparison>

[0122] Trimethylol propane as the a1 component, a dimer acid (TSUNODYME 395 manufactured by TSUNO CO., LTD., a content ratio of a dicarboxylic acid having 36 carbon atoms of 95%) as the b1 component, and 2-hexyl-1-decanol as the c1 component were fed such that the ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of the monool became 1/2.11/1.45. The mixture was condensed by using the same method as that in the synthesis of A-1, and thus, composite ester X-2 for comparison was obtained.

<Synthesis of Composite Ester X-3 for Comparison>

[0123] Trimethylol propane as the a1 component, a dimer acid (TSUNODYME 395 manufactured by TSUNO CO., LTD., a content ratio of a dicarboxylic acid having 36 carbon atoms of 95%) as the b1 component, and 2-hexyl-1-decanol as the c1 component were fed such that the ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of the monool became 1/1.48/0.73. The mixture was condensed by using the same method as that in the synthesis of A-1, and thus, composite ester X-3 for comparison was obtained.

<Synthesis of Composite Ester X-4 for Comparison>

[0124] In the synthesis of the composite ester A-1, 50 mol% of the dimer acid was substituted with an adipic acid, and the components were fed such that the ratio of the number of moles of the hydroxyl group of a1/the number of moles of the carboxylic acid of b1/the number of moles of the hydroxyl group of the monool became 1/0.92/1.01. The mixture was condensed by using the same method as that in the synthesis of the composite ester A-1, and thus, composite ester X-4 for comparison was obtained.

[0125] The compositions of the composite esters X-1 to X-4 for comparison are as shown in Table 2.

[Table 2]

Composite Ester for Comparison	a1		b1		c1		Mol of Hydroxyl Group of a1/Mol of Carboxylic Acid of b1/Mol of Hydroxyl Group of c1	Total Mol of Hydroxyl Group/Total Mol of Carboxylic Acid	Kinematic Viscosity at 40°C mm ² /s	Acid Value mgKOH/g	Monool Residue
	Type	Molar Ratio	Type	Molar Ratio	Type	Molar Ratio					
X-1	TMP	1	C36-1	1.25	HD16B	3.5	1/1.4/1	1/0.86	780	6.1	<3%
			Adipic Acid	0.31							
X-2	TMP	1	C36-1	3.16	HD16B	4.37	1/2.11/1.45	1/0.86	450	6	<3%
X-3	TMP	1	C36-1	2.22	HD16B	2.19	1/1.48/0.73	1/0.86	2,200	6.3	<3%
X-4	TMP	1	C36-1	1.375	HD16B	3.025	1/0.92/1.01	1/0.91	710	4.5	5%
			Adipic Acid	1.375							

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(Examples 1 to 28)

[0126] The composite ester A shown in Table 1 was mixed with base oil, and thus, a lubricant composition was prepared. Furthermore, the following oil was used as the base oil.

B1: Mineral Oil (SUPER OIL N46 manufactured by JX Nippon Oil & Energy Corporation), and Kinematic Viscosity at 40°C of 46.1 mm²/s

B2: Poly α Olefin Oil (ANDEROL FGC 32 manufactured by ANDEROL Inc.), and Kinematic Viscosity at 40°C of 32.6 mm²/s

B3: Ester Oil (ANDEROL 495 manufactured by ANDEROL Inc.), and Kinematic Viscosity at 40°C of 28.0 mm²/s

B4: Base Oil in which Mo Dithiocarbamate was added to B1 such that Mo Content became 500 ppm and Zn Dithiophosphate was added to B1 such that Zn Content became 1,000 ppm, and Kinematic Viscosity at 40°C of 46.2 mm²/s

(Comparative Examples 1 to 8)

[0127] The composite ester A shown in Table 1 or the composite ester for comparison shown in Table 2 were mixed with base oil, and thus, a lubricant composition was prepared.

(Evaluation)

<Friction Coefficient Evaluation>

[0128] The lubricant composition of each of the examples and the comparative examples was subjected to a friction abrasion test at each of a temperature of 40°C (Condition 1) and a temperature of 80°C (Condition 2) for 1 hour in conditions of the number of vibrations of 50 Hz, a load of 10 N, an amplitude of vibration of 1 mm by using a vibration type friction abrasion tester (Product Name: SRV 3 manufactured by Optimol Instruments Prueftechnik GmbH), and thus, a friction coefficient at a time of 30 minutes was measured. An SUJ-2 ball of 10 mm was used as an upper test piece, and an SUJ-2 disk of 24 mm was used as a lower test piece. The upper test piece after the test was observed by using a microscope, but abrasion was rarely observed, and it was considered that a friction behavior of a mixed lubrication region was observed from a fluid lubrication region. The observed friction coefficient was evaluated on the basis of the following standards. The results are shown in Table 4 described below.

[0129] The friction coefficient of Comparative Example 1 in Condition 1 was set to 100%, other evaluation results were standardized, and evaluation was performed as described below. As the value becomes smaller, the friction coefficient decreases and lubrication properties are excellent. a and b were determined that a decrease in the friction coefficient was considerable and an improvement effect was considerable. c and d were determined that a decrease in the friction coefficient was observed but the improvement effect was not considerable. e was determined that the improvement effect less than or equal to that of Comparative Example 1 was not obtained. Furthermore, in the test in Conditions 1 and 2, evaluation of higher than or equal to b was set to acceptable evaluation.

a: Less than 60%

b: Greater than or equal to 60% and less than 70%

c: Greater than or equal to 70% and less than 80%

d: Greater than or equal to 80% and less than 95%

e: Greater than or equal to 95%

<Abrasion Evaluation>

[0130] The same test as the friction coefficient test were performed except that the load and the temperature were set to the following conditions in the tester described above.

[Table 3]

	Abrasion Test 1 (Condition 3)	Abrasion Test 2 (Condition 4)
Load	300 N	400 N
Temperature	80°C	120°C

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An abrasion mark of the upper test piece after the test was observed by using a microscope. The diameter of the abrasion mark obtained in Abrasion Test 1 of Comparative Example 1 was set to 100%, standardization was performed, and evaluation was performed on the basis of the following standards. The results are shown in Table 4 described below.

[0131] The abrasion decreases as the value becomes smaller. a to c were determined that the abrasion mark was apparently small and the improvement effect was considerable. d was determined that the abrasion mark was small but the effect was not considerable. e was determined that the improvement effect equal to that in Abrasion Test 1 of Comparative Example 1 was not obtained. f was determined that the abrasion was greater than that in Abrasion Test 1 of Comparative Example 1. Furthermore, in the test in Conditions 3 and 4, evaluation of higher than or equal to c was set to acceptable evaluation.

a: Less than 50%

b: Greater than or equal to 50% and less than 70%

c: Greater than or equal to 70% and less than 85%

d: Greater than or equal to 85% and less than 95%

e: Greater than or equal to 95% and less than 105%

f: Greater than or equal to 105%

The compositions and the evaluation results of the lubricant compositions of the examples and the comparative examples are shown in Table 4.

[0132]

[Table 4]

	Composite Ester A		Base Oil	Lubricant Composition Kinematic Viscosity (mm ² /s)	Condition 1 Friction Coefficient 40°C	Condition 2 Friction Coefficient 80°C	Condition 3 Abrasion Test 1	Condition 4 Abrasion Test 2
	Type	Added Amount (Mass%)						
Example 1	A-1	0.1	B1	46.2	b	b	b	c
Example 2	A-1	0.3	B1	46.5	a	b	b	b
Example 3	A-1	0.5	B1	46.8	a	a	a	b
Example 4	A-1	1	B1	47.4	a	a	a	b
Example 5	A-1	2	B1	48.8	a	a	a	b
Example 6	A-1	3	B1	50.2	a	b	a	b
Example 7	A-1	5	B1	53	b	b	a	b
Example 8	A-2	1	B1	47.4	a	a	a	b
Example 9	A-3	1	B1	47.4	a	a	a	b
Example 10	A-4	1	B1	47.2	a	a	a	b
Example 11	A-5	1	B1	47.5	a	a	a	b
Example 12	A-6	1	B1	47.5	a	b	a	b
Example 13	A-7	1	B1	47.6	a	b	a	b
Example 14	A-8	1	B1	47.7	a	b	a	b
Example 15	A-9	1	B1	47.3	a	b	a	b
Example 16	A-10	1	B1	47.4	a	b	a	b
Example 17	A-11	1	B1	47.6	a	b	a	b
Example 18	A-12	1	B1	47.4	a	b	a	b
Example 19	A-1	1	B2	32.7	a	a	a	b
Example 20	A-1	1	B3	28.2	a	a	a	b
Example 21	A-13	1	B1	46.5	a	a	a	b
Example 22	A-14	1	B1	46.6	a	b	a	b

(continued)

	Composite Ester A		Base Oil	Lubricant Composition Kinematic Viscosity (mm ² /s)	Condition 1 Friction Coefficient 40°C	Condition 2 Friction Coefficient 80°C	Condition 3 Abrasion Test 1	Condition 4 Abrasion Test 2
	Type	Added Amount (Mass%)						
Example 23	A-1	1	B4	47.6	a	a	a	a
Example 24	A-15	1	B1	47.9	b	b	b	b
Example 25	A-16	1	B1	48.0	b	b	b	b
Example 26	A-5	2	B4	48.2	a	a	a	a
Example 27	A-6	2	B4	48.4	a	a	a	b
Example 28	A-7	2	B4	48.6	a	a	a	b
Comparative Example 1	None	None	B1	46.1	e	e	e	f
Comparative Example 2	A-1	10	B1	61.1	e	e	b	b
Comparative Example 3	A-1	20	B1	80.9	e	e	b	b
Comparative Example 4	X-1	1	B1	47.4	b	b	c	d
Comparative Example 5	X-2	1	B1	47.2	b	b	c	d
Comparative Example 6	X-3	1	B1	47.9	b	b	c	d
Comparative Example 7	X-3	5	B1	55.9	c	c	b	c
Comparative Example 8	X-4	1	B1	47.4	b	b	c	d

[0133] From Table 4, in the examples, it is found that excellent lubrication properties and excellent abrasion resistance are exhibited in a wide temperature range and wide load conditions. In contrast, in the comparative examples, it is found that the lubrication properties and the abrasion resistance are not compatible.

[0134] Next, grease (SHC Grease 460 WT manufactured by Exxon Mobil Corporation.) and the composite ester A were mixed well, and thus, a grease composition was obtained. The obtained grease composition was subjected to a test by using the same method as that in the abrasion evaluation described above, and evaluation was performed as described below. Furthermore, in the evaluation, the diameter of the abrasion mark obtained in Abrasion Test 1 of Comparative Example G1 was set to 100%, standardization was performed, and evaluation was performed on the basis of the following standards. The results are shown in the following table.

[0135] The abrasion decreases as the value becomes smaller. a to c were determined that the abrasion mark was apparently small and the improvement effect was considerable. d was determined that the abrasion mark was small but the effect was not considerable. e was determined that the improvement effect equal to that in Abrasion Test 1 of Comparative Example G1 was not obtained. f was determined that the abrasion was greater than that in Abrasion Test 1 of Comparative Example G1. Furthermore, in the test in Conditions 3 and 4, evaluation of higher than or equal to c was set to acceptable evaluation.

a: Less than 50%

b: Greater than or equal to 50% and less than 70%

c: Greater than or equal to 70% and less than 85%

d: Greater than or equal to 85% and less than 95%

e: Greater than or equal to 95% and less than 105%

f: Greater than or equal to 105%

[Table 5]

		Composite Ester A		Condition 3	Condition 4
		Type	Added Amount (Mass%)	Abrasion Test 1	Abrasion Test 2
Example G1	Grease	A-1	1	a	b
Example G2	Grease	A-1	2	a	b
Example G3	Grease	A-1	5	a	b
Comparative Example G1	Grease	None	-	e	f

[0136] From Table 5, in the examples, it is found that excellent abrasion resistance are exhibited in a wide temperature range and wide load conditions. Thus, the lubricant composition of the present invention exhibits excellent lubrication properties even in the grease composition.

Claims

1. A lubricant composition, containing at least:

trivalent or more polyol a1;

a mixture b1 of at least one of a polymerization reaction mixture of an unsaturated fatty acid having 18 to 22 carbon atoms which contains at least 75 mass% of a divalent carboxylic acid having 36 to 44 carbon atoms or a mixture obtained by performing hydrogenation with respect to the polymerization reaction mixture; and

composite ester A containing polyester in which monool c1 represented by General Formula (1) described below is condensed,

wherein a feed ratio of the number of moles of a hydroxyl group of a1/the number of moles of a carboxylic acid of b1/the number of moles of a hydroxyl group of c1 is 1/1.5 to 2.0/0.7 to 1.5, and

a content of the composite ester A is 0.1 to 5 mass% with respect to the total mass of the lubricant composition,

General Formula (1): R-OH

in General Formula (1), R represents a linear alkyl group having greater than or equal to 8 carbon atoms or a

branched alkyl group having greater than or equal to 8 carbon atoms.

2. The lubricant composition according to claim 1,

5 wherein in General Formula (1) described above, R is a linear alkyl group having 8 to 25 carbon atoms or a branched alkyl group having 8 to 25 carbon atoms.

3. The lubricant composition according to claim 1 or 2,

10 wherein in General Formula (1) described above, R is a linear alkyl group having 16 to 20 carbon atoms or a branched alkyl group having 16 to 20 carbon atoms.

4. The lubricant composition according to any one of claims 1 to 3,

15 wherein in General Formula (1) described above, R is a branched alkyl group.

5. The lubricant composition according to any one of claims 1 to 4,

20 wherein the content of the composite ester A is 0.5 to 2 mass% with respect to the total mass of the lubricant composition.

6. The lubricant composition according to any one of claims 1 to 5,

25 wherein in a case in which the total number of moles of the hydroxyl group of the number of moles of the hydroxyl group of a1 and the number of moles of the hydroxyl group of c1 is set to P, and the number of moles of the carboxylic acid of b1 is set to Q, a feed ratio of P/Q is 1/0.7 to 0.95.

7. The lubricant composition according to any one of claims 1 to 6,

30 wherein a kinematic viscosity of the composite ester A at 40°C is 500 to 2,000 mm²/s.

8. The lubricant composition according to any one of claims 1 to 7,

35 wherein the kinematic viscosity at 40°C is 5 to 100 mm²/s.

9. The lubricant composition according to any one of claims 1 to 8, further containing:

40 a medium,
wherein 0.1 to 5 mass% of the composite ester A is contained, and 70 to 99.9 mass% of the medium is contained, with respect to the total mass of the lubricant composition, and
0 to 29.9 mass% of other components other than the composite ester A and the medium are contained with respect to the total mass of the lubricant composition.

10. The lubricant composition according to claim 9,

45 wherein the medium is at least one type selected from mineral oil, polyolefin oil, ester oil, and ether oil.

11. The lubricant composition according to claim 9 or 10,

50 wherein the other components are compounds having at least one type of zinc, molybdenum, sulfur, or phosphorus as a constituent element.

12. The lubricant composition according to any one of claims 9 to 11,

55 wherein the other components are at least one type of an organic molybdenum compound or an organic zinc compound.

13. The lubricant composition according to any one of claims 1 to 12,

wherein the lubricant composition is used as lubricating oil for grease, a releasing agent, oil for an internal combustion engine, oil for metal working (cutting), bearing oil, fuel for a combustion engine, vehicle engine oil, gear oil, operating oil for an automobile, lubricating oil for a vessel and an aircraft, machine oil, turbine oil, bearing oil, hydraulic operating oil, compressor and vacuum pump oil, freezer oil, a lubricating oil agent for metal working, a lubricant for a magnetic recording medium, a lubricant for a micro machine, a lubricant for an artificial bone, or rolling oil.

14. A manufacturing method of a lubricant composition, comprising:

obtaining a composite ester A; and
 obtaining a lubricant composition in which a concentration of the composite ester A is 0.1 to 5 mass%,
 wherein obtaining the composite ester A is mixing and condensing at least trivalent or more polyol a1, a mixture b1 of at least one of a polymerization reaction mixture of an unsaturated fatty acid having 18 to 22 carbon atoms which contains at least 75 mass% of a divalent carboxylic acid having 36 to 44 carbon atoms or a mixture obtained by performing hydrogenation with respect to the polymerization reaction mixture, and monool c1 represented by General Formula (1) described below such that the number of moles of a hydroxyl group of a1/the number of moles of a carboxylic acid of b1/the number of moles of a hydroxyl group of c1 becomes 1/1.5 to 2.0/0.7 to 1.5,

General Formula (1): R-OH

in General Formula (1), R represents a linear alkyl group having greater than or equal to 8 carbon atoms or a branched alkyl group having greater than or equal to 8 carbon atoms.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/071138

A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C10M129/78, C10M101/02, C10M105/18, C10M105/32, C10M107/02, C10M107/34,
C10N10/04, C10N10/12, C10N20/02, C10N40/00, C10N40/02, C10N40/04,
C10N40/08, C10N40/12, C10N40/18, C10N40/20, C10N40/22, C10N40/24,

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

JSTPlus/JMEDPlus/JST7580(JDreamIII), CAplus/REGISTRY (STN)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2011/037217 A1 (Fujifilm Corp.), 31 March 2011 (31.03.2011), claims; examples; comparative examples 25 to 29 & JP 2011-89106 A & US 2012/0184474 A1	1-14
A	JP 59-33395 A (Kawasaki Steel Corp. et al.), 23 February 1984 (23.02.1984), entire text (Family: none)	1-14

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:

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"&" document member of the same patent family

Date of the actual completion of the international search
24 August 2015 (24.08.15)Date of mailing of the international search report
01 September 2015 (01.09.15)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/071138

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2001-500549 A (Exxon Chemical Patents Inc.), 16 January 2001 (16.01.2001), entire text & JP 2001-501989 A & JP 2001-507334 A & JP 2002-509563 A & US 5994278 A & US 5922658 A & US 5942475 A & WO 1998/010039 A1 & WO 1998/010040 A1 & WO 1998/010041 A1 & WO 1998/010042 A1 & WO 1998/010043 A1	1-14
P,X	WO 2015/016258 A1 (Fujifilm Corp.), 05 February 2015 (05.02.2015), entire text (Family: none)	1-14
P,X	JP 2015-71685 A (Fujifilm Corp.), 16 April 2015 (16.04.2015), entire text (Family: none)	1-14

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2015/071138

Continuation of A. CLASSIFICATION OF SUBJECT MATTER

(International Patent Classification (IPC))

C10M129/78(2006.01)i, C10M101/02(2006.01)i, C10M105/18(2006.01)i,
 C10M105/32(2006.01)i, C10M107/02(2006.01)i, C10M107/34(2006.01)i,
 C10N10/04(2006.01)n, C10N10/12(2006.01)n, C10N20/02(2006.01)n,
 C10N40/00(2006.01)n, C10N40/02(2006.01)n, C10N40/04(2006.01)n,
 C10N40/08(2006.01)n, C10N40/12(2006.01)n, C10N40/18(2006.01)n,
 C10N40/20(2006.01)n, C10N40/22(2006.01)n, C10N40/24(2006.01)n,
 C10N40/25(2006.01)n, C10N40/30(2006.01)n, C10N40/36(2006.01)n

(According to International Patent Classification (IPC) or to both national
 classification and IPC)

Continuation of B. FIELDS SEARCHED

Minimum documentation searched (International Patent Classification (IPC))

C10N40/25, C10N40/30, C10N40/36

Minimum documentation searched (classification system followed by
 classification symbols)

REFERENCES CITED IN THE DESCRIPTION

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