USE OF POLYESTERS AS LUBRICANTS

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ABSTRACT

The presently claimed invention is directed to the novel use of polyester obtainable by reacting a mixture comprising cyclohexane-1,2-dicarboxylic acid and an alcohol mixture comprising 1-nonanol, monomethyloctanols, dimethyloctanols and monoethylheptanols and subsequent hydrogenation of said total mixture as lubricants and a lubricant composition comprising these polyesters.
USE OF POLYESTERS AS LUBRICANTS

[0001] The presently claimed invention is directed to the novel use of polyester obtainable by reacting a mixture comprising cyclohexane-1,2-dicarboxylic acid and an alcohol mixture comprising 1-nonenol, monomethylolactones, dimethylolpropanols and monooctylolpropanols as lubricants and subsequent hydrogenation of said total mixture and a lubricant composition comprising these polyesters.

[0002] The commercially available lubricant compositions are produced from a multitude of different natural or synthetic components. The lubricant compositions comprise base oils and further additives. The base oils often consist of mineral oils, highly refined mineral oils, alkylated mineral oils, poly-alpha-olefins (PAOs), polyalkylene glycols, phosphate esters, silicone oils, diesters and esters of polyhydric alcohols.

[0003] Currently Group I and Group III hydrorefined paraffinic mineral oil, G1T synthetic oil and poly-alpha-olefin are preferably used as base oil in lubricant compositions. However, these base oils have a detrimental effect on sealing materials which form a part of engines and mechanical transmission units. In particular, the use of these base oils leads to the shrinkage of sealing materials such as acrylonitrile butadiene rubber.

[0004] It is known that polyesters, however, accelerate the expansion of these sealing materials. Thus, specific polyesters are used in lubricant compositions in order to counteract the shrinking effect of modern base oils.

[0005] At present, DIDA (diisodecyl adipate), DITA (diisotridecyl adipate) and TMTIC (trimethylolpropanolcaprylate) are used to achieve this purpose. The cloud points of these esters lie at ~30 °C, ~20 °C and ~10 °C, respectively.

[0006] In view of the properties of existing polyesters there is still a need to provide novel polyesters that show improved low temperature properties as expressed by low cloud points while maintaining overall advantageous characteristics of lubricant formulations such as expansions of sealing materials such as acrylonitrile butadiene rubber, when used as a component of a lubricant composition.

[0007] Thus, it is an object of the present invention to provide polyesters that show improved low temperature properties as expressed by low cloud points and lead to a high degree of expansion of sealing materials such as acrylonitrile butadiene rubber when used as a component of a lubricant composition.

[0008] The object is solved by means of using a polyester obtainable by reacting a total mixture comprising phthalic acid, optionally in form of its esters or its anhydrides, and an alcohol mixture comprising 1-nonenol, monomethylolactones, dimethylolpropanols and monooctylolpropanols and subsequent hydrogenation of said total mixture, whereby the polyester has a dynamic viscosity at 20 °C in the range of 40 to 64 mPa.s determined according to DIN 51562-1, as a lubricant.

[0009] The dynamic viscosity of the polyester at 20 °C is preferably from 42 to 62 mPa.s, more preferably from 44 to 60 mPa.s determined according to DIN 51562-1.

[0010] The polyesters of the invention preferably have densities at 20 °C according to DIN 51757 of from 0.85 to 1.00 g/cm³, more preferably from 0.90 to 0.98 g/cm³ and most preferably from 0.94 to 0.96 g/cm³. The refractive index nD20, according to DIN 5422 is preferably from 1.455 to 1.469, more preferably from 1.456 to 1.468, and most preferably from 1.460 to 1.466.

[0011] The alcohol mixture used according to the invention is particularly advantageously obtainable in a process involving two or more stages and starting from a hydrocarbon mixture comprising butenes. In a first step, the butenes are dimerized to give a mixture of isomeric octenes. The octene mixture is then hydroformylated to give C8 aldehydes and then hydrogenated to give the alcohol mixture. In this reaction sequence, specific, defined parameters have to be adhered to, at least during the butene dimerization, preferably during the butene dimerization and the hydroformylation.

[0012] It is preferable, therefore, that the isomeric octenes mixture is obtained by bringing a hydrocarbon mixture comprising butenes into contact with a heterogeneous catalyst comprising nickel oxide. The isobuten content of the hydrocarbon mixture is preferably 5% by weight or less, in particular 3% by weight or less, particularly preferably 1% by weight or less, and at most preferably 1.5% by weight or less, based in each case on the total butene content. A suitable hydrocarbon stream is that known as the C4 cut, a mixture of butenes and butanes, available in large quantities from FCC plants or from steam crackers. A starting material used with particular preference is that known as naphtha II, which is an isobutene-depleted C4 cut.

[0013] A preferred starting material comprises from 50 to 100% by weight, preferably from 80 to 95% by weight, of butanes and from 0 to 50% by weight, preferably from 5 to 20% by weight, of butenes. The following makeup of the butenes can be given as a general guide to quantities:

<table>
<thead>
<tr>
<th>Isomer</th>
<th>Proportion (w%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-butene</td>
<td>from 1 to 98%</td>
</tr>
<tr>
<td>cis-2-butene</td>
<td>from 1 to 50%</td>
</tr>
<tr>
<td>trans-2-butene</td>
<td>from 1 to 98%</td>
</tr>
<tr>
<td>isobutene</td>
<td>up to 5%</td>
</tr>
</tbody>
</table>

[0014] Possible catalysts are catalysts known per se and comprising nickel oxide, as described, for example, by O'Connor et al. in Catalysis Today, 6, (1990) p. 329. Supported nickel oxide catalysts may be used, and possible support materials are silica, alumina, aluminosilicates, aluminosilicates having a layered structure and zeolites. Particularly suitable catalysts are precipitation catalysts obtainable by mixing aqueous solutions of nickel salts and of silicates, e.g. of sodium silicate and sodium nitrate, and, where appropriate, of other constituents, such as aluminum salts, e.g. aluminum nitrate, and calcining.

[0015] Particular preference is given to catalysts which essentially consist of NiO, SiO₂, TiO₂ and/or ZrO₂, and also, where appropriate, Al₂O₃. A most preferred catalyst comprises, as significant active constituents, from 10 to 70% by weight of nickel oxide, from 5 to 30% by weight of titanium dioxide and/or zirconium dioxide and from 0 to 20% by weight of aluminum oxide, the remainder being silicon dioxide. A catalyst of this type is obtainable by precipitating the catalyst composition at pH from 5 to 9 by adding an aqueous solution comprising nickel nitrate to an aqueous alkali metal water glass solution which comprises titanium dioxide and/or zirconium dioxide, filtering, drying and annealing at from 350 to 650 °C. For details of preparation of these catalysts reference may be made to DE-A 4339713. The entire content of the disclosure of that publication is incorporated herein by way of reference.

[0016] The hydrocarbon mixture comprising butenes is brought into contact with the catalyst, preferably at temperatures of from 30 to 280 °C, in particular from 30 to 140 °C.
and particularly preferably from 40 to 130°C. This preferably takes place at a pressure of from 10 to 300 bar, in particular from 15 to 100 bar and particularly preferably from 20 to 80 bar. The pressure here is usefully set in such a way that the olefin-rich hydrocarbon mixture is liquid or in the supercritical state at the temperature selected.

[0017] Examples of reactors suitable for bringing the hydrocarbon mixture into contact with the heterogeneous catalyst are tube-bundle reactors and shaft furnaces. Shaft furnaces are preferred because the capital expenditure costs are lower. The dimerization may be carried out in a single reactor, where the oligomerization catalyst may have been arranged in one or more fixed beds. Another way is to use a reactor cascade composed of two or more, preferably two, reactors arranged in series, where the butene dimerization in the reaction mixture is driven to only partial conversion on passing through the reactor(s) preceding the last reactor of the cascade, and the desired final conversion is not achieved until the reaction mixture passes through the last reactor of the cascade. The butene dimerization preferably takes place in an adiabatic reactor or in an adiabatic reactor cascade.

[0018] After leaving the reactor or, respectively, the last reactor of a cascade, the octenes formed and, where appropriate, higher oligomers, are separated off from the unconverted butenes and butanes in the reactor discharge. The oligomers formed may be purified in a subsequent vacuum fractionation step, giving a pure octene fraction. During the butene dimerization, small amounts of dodecanes are generally also obtained. These are preferably separated off from the octenes prior to the subsequent reaction.

[0019] In a preferred embodiment, some or all of the reactor discharge, freed from the oligomers formed and essentially consisting of unconverted butenes and butanes, is returned. It is preferable to select the return ratio such that the concentration of oligomers in the reaction mixture does not exceed 35% by weight, preferably 20% by weight, based on the hydrocarbon mixture of the reaction. This measure increases the selectivity of the butene dimerization in relation to those octenes which, after hydroformylation, hydrogenation and esterification, give a particularly preferred alcohol mixture.

[0020] The octenes obtained are converted, in the second process step, by hydroformylation using synthesis gas in a manner known per se, into aldehydes having one additional carbon atom. The hydroformylation of olefins to prepare aldehydes is known per se and is described, for example, in J. Falbe, (ed.): New Synthesis with Carbon monoxide, Springer, Berlin, 1980. The hydroformylation takes place in the presence of catalysts homogeneously dissolved in the reaction medium. The catalysts generally used here are compounds or complexes of metals of transition group VIII, specifically Co, Rh, Ir, Pd, Pt or Ru compounds, or complexes of these metals, either unmodified or modified, for example, using amine-containing or phosphate-containing compounds.

[0021] For the purposes of the present invention, the hydroformylation preferably takes place in the presence of a cobalt catalyst, in particular dicobalt octacarbonyl [Co₂(CO)₉]. It preferably takes place at from 120 to 240°C, in particular from 160 to 200°C, and under a synthesis gas pressure of from 150 to 400 bar, in particular from 250 to 350 bar. The hydroformylation preferably takes place in the presence of water. The ratio of hydrogen to carbon monoxide in the synthesis gas mixture used is preferably in the range from 70:30 to 50:50, in particular from 65:35 to 55:45.

[0022] The cobalt-catalyzed hydroformylation process may be carried out as a multistage process which comprises the following 4 stages: the preparation of the catalyst (precarbonylation), the catalyst extraction, the olefin hydroformylation and the removal of the catalyst from the reaction product (decobaltization). In the first stage of the process, the precarbonylation, an aqueous cobalt salt solution, e.g., cobalt formate or cobalt acetate, as starting material is reacted with carbon monoxide and hydrogen to prepare the catalyst complex needed for the hydroformylation. In the second stage of the process, the catalyst extraction, the cobalt catalyst prepared in the first stage of the process is extracted from the aqueous phase using an organic phase, preferably using the olefin to be hydroformylated. Besides the olefin, it is occasionally advantageous to use the reaction products and byproducts of the hydroformylation for catalyst extraction, as long as these are insoluble in water and liquid under the reaction conditions selected. After the phase separation, the organic phase loaded with the cobalt catalyst is fed to the third stage of the process, the hydroformylation. In the fourth stage of the process, the decobaltization, the organic phase of the reactor discharge is freed from the cobalt carbonyl complexes in the presence of process water, which may comprise formic acid or acetic acid, by treatment with oxygen or air. During this, the cobalt catalyst is destroyed by oxidation and the resultant cobalt salts are extracted back into the aqueous phase. The aqueous cobalt salt solution obtained from the decobaltization is returned to the first stage of the process, the precarbonylation. The raw hydroformylation product obtained may be fed directly to the hydrogenation. Another way is to isolate a C₉ fraction from this in a usual manner, e.g., by distillation, and feed this to the hydroformylation.

[0023] The formation of the cobalt catalyst, the extraction of the cobalt catalyst into the organic phase and the hydroformylation of the olefins can also be carried out in a single-stage process in the hydroformylation reactor.

[0024] Examples of cobalt compounds which can be used are cobalt(II) chloride, cobalt(II) nitrate, the amine complexes or hydrate complexes of these, cobalt carboxylates, such as cobalt formate, cobalt acetate, cobalt ethylhexanoate and cobalt naphthenate (Co salts of naphthenic acid), and also the cobalt caprolactamate complex. Under the conditions of the hydroformylation, the catalytically active cobalt compounds form in situ as cobalt carboxyls. It is also possible to use carboxyl complexes of cobalt such as dicobalt octacarbonyl, tetracobalt dodecarbonyl and hexacobalt hexadecacarbonyl.

[0025] The aldehyde mixture obtained during the hydroformylation is reduced to give primary alcohols. A partial reduction generally takes place straight away under the conditions of the hydroformylation, and it is also possible to control the hydroformylation in such a way as to give essentially complete reduction. However, the hydroformylation product obtained is generally hydrogenated in a further process step using hydrogen gas or a hydrogen-containing gas mixture. The hydrogenation generally takes place in the presence of a heterogeneous hydrogenation catalyst. The hydrogenation catalyst used may comprise any desired catalyst suitable for hydrogenating aldehydes to give primary alcohols. Examples of suitable commercially available catalysts are copper chromite, cobalt, cobalt compounds, nickel, nickel compounds, which, where appropriate, comprise small amounts of chromium or of other promoters, and mixtures of copper, nickel and/or chromium. The nickel compounds are
generally in a form supported on support materials, such as alumina or kieselguhr. It is also possible to use catalysts comprising noble metals, such as platinum or palladium.

[0026] A suitable method of carrying out the hydrogenation is a trickle-flow method, where the mixture to be hydrogenated and the hydrogen gas or, respectively, the hydrogen-containing gas mixture are passed, for example concurrently, over a fixed bed of the hydrogenation catalyst.

[0027] The hydrogenation preferably takes place at from 50 to 250 °C, in particular from 100 to 150 °C, and at a hydrogen pressure of from 50 to 350 bar, in particular from 150 to 300 bar. The desired isononanol fraction in the reaction discharge obtained during the hydrogenation can be separated off by fractional distillation from the C₈ hydrocarbons and higher-boiling products.

[0028] Gas-chromatographic analysis of the resultant alcohol mixture can give the relative amounts of the individual compounds (the percentages given being percentages by gas chromatogram area):

[0029] The proportion of 1-nonenol in the alcohol mixture of the invention is preferably from 6 to 16% by weight, more preferably from 8 to 14% by weight, related to the overall weight of the alcohol mixture.

[0030] The proportion of the monomethylactanols is preferably from 25 to 55% by weight, more preferably from 35 to 55% by weight, and it is particularly preferable for 6-methyl-1-octanol and 4-methyl-1-octanol together to make up at least 25% by weight, very particularly preferably at least 35% by weight, related to the overall weight of the alcohol mixture.

[0031] The proportion of the dimethylheptanols and monomethylheptanols is preferably from 15 to 60% by weight, more preferably from 20 to 55% by weight, and it is preferable for 2,5-dimethyl-1-heptanol, 3-ethyl-1-heptanol and 4,5-dimethyl-1-heptanol together to make up at least 15% and in particular 20% by weight, related to the overall weight of the alcohol mixture. The proportion of the hexanols is preferably from 4 to 10% by weight and more preferably from 5 to 10% by weight, related to the overall weight of the alcohol mixture.

[0032] The alcohol mixture of the invention is preferably composed of from 70 to 100%, more preferably from 70 to 98%, most preferably from 80 to 98% and even more preferably from 85 to 95%, of a mixture of 1-nonenol, monomethylactanols, dimethylheptanols and monomethylheptanols, related to the overall weight of the alcohol mixture.

[0033] Preferably the alcohol mixture contains a proportion of 6% by weight to 16% by weight, 25% by weight to 55% by weight, 10% by weight to 30% by weight dimethylheptanols and 7% by weight to 15% by weight monoethylheptanols, related to the overall weight of the alcohol mixture.

[0034] Preferably the alcohol mixture is present in a molar ratio in the range of 1:1 to 2:1, more preferably in a molar ratio in the range of 1:1 to 1.3:1, in relation to phthalic acid, optionally in form of its esters or its anhydrides.

[0035] Preferably the alcohol mixture contains a proportion of 6.0 to 16.0% by weight, preferably 7.0 to 15.0% by weight, particularly preferably 8.0 to 14.0% by weight, of n-nonanol; 12.8 to 28.8% by weight, preferably 14.8 to 26.8% by weight, particularly preferably 15.8 to 25.8% by weight, of 6-methylheptanol; 12.5 to 28.8% by weight, preferably 14.5 to 26.5% by weight, particularly preferably 15.5 to 25.5% by weight, of 4-methylheptanol; 3.3 to 7.3% by weight, preferably 3.8 to 6.8% by weight, particularly preferably 4.3 to 6.3% by weight, of 2-methyloctanol; 5.7 to 11.7% by weight, preferably 6.3 to 11.3% by weight, particularly preferably 6.7 to 10.7% by weight, of 3-ethylheptanol; 1.9 to 3.9% by weight, preferably 2.1 to 3.7% by weight, particularly preferably 2.4 to 3.4% by weight, of 2-ethylheptanol; 1.7 to 3.7% by weight, preferably 1.9 to 3.5% by weight, particularly preferably 2.2 to 3.2% by weight, of 2-propylhexanol; 3.2 to 9.2% by weight, preferably 3.7 to 8.7% by weight, particularly preferably 4.2 to 8.2% by weight, of 3,5-dimethylheptanol; 6.0 to 16.0% by weight, preferably 7.0 to 15.0% by weight, particularly preferably 8.0 to 14.0% by weight, of 2,5-dimethylheptanol; 1.8 to 3.8% by weight, preferably 2.0 to 3.6% by weight, particularly preferably 2.3 to 3.3% by weight, of 2,3-dimethylheptanol; 0.6 to 2.6% by weight, preferably 0.8 to 2.4% by weight, particularly preferably 1.1 to 2.1% by weight, of 3-ethyl-4-methylhexanol; 2.0 to 4.0% by weight, preferably 2.2 to 3.8% by weight, particularly preferably 2.5 to 3.5% by weight, of 2-ethyl-4-methylhexanol; 0.5 to 6.5% by weight, preferably 1.5 to 6% by weight, particularly preferably 1.5 to 5.5% by weight, of other alcohols having 9 carbon atoms; the total sum of said components being 100% by weight.

[0036] The density of the alcohol mixture of the invention at 20°C is preferably from 0.75 to 0.9 g/cm³, more preferably from 0.8 to 0.88 g/cm³, and most preferably from 0.82 to 0.84 g/cm³. The refractive index nD²⁰ is preferably from 1.42 to 1.445, preferably from 1.43 to 1.44, and most preferably from 1.432 to 1.438. The boiling range at atmospheric pressure is preferably from 190 to 220°C, more preferably from 195 to 215°C, and most preferably from 200 to 210°C.

[0037] The preparation of the polyessters of the invention is carried out in a manner known per se (cf., for example, “Ullmann’s Encyclopedia of Industrial Chemistry”, 5th edition, VCH Verlagsgesellschaft mbH, Weinheim, Vol. A1, pp. 214 et seq. and Vol. A9, pp. 572-575). The chain length and, respectively, average molecular weight of the polyessters can be controlled via the juncture at which the alcohol mixture is added and the amount of this mixture, and these may readily be determined as a matter of routine by the skilled worker. The catalysts used comprise conventional esterification catalysts, preferably diacyl titanates ((RO)₂TiO₂, where examples of R are iso-propyl, n-butyl and isobutyl), methanesulfonic acid and sulfuric acid, more preferably the catalyst is isopropyl-n-butyl titinate.

[0038] In one preferred embodiment, the initial charge in the reaction vessel comprises phthalic acid and the entire amount of the alcohol mixture. This reaction mixture is first heated to 100-140°C and homogenized by stirring. Heating then continues at 160-190 °C at atmospheric pressure. The esterification, with elimination of water, preferably begins at about 150°C. The water of reaction formed is removed by distillation via a column. If the alcohol mixture distills over during this procedure, it is returned to the reaction vessel. The reaction vessel is then heated to 200-250°C, and further water of reaction is stripped at a pressure of from 150 to 300 mbar, by passing nitrogen through the reaction mixture. Residual water and excess alcohol mixture are stripped here, using an increased flow of nitrogen and stirring. The reaction mixture is then filtered at 100-140°C.

[0039] Preferably hydrogenation of the total mixture is carried out with a gas comprising hydrogen in the presence of a catalyst which comprises, as active metal, at least one metal of subgroup VIII of the Periodic Table of the Elements, alone
or together with at least one metal of subgroup I or VII of the Periodic Table of the Elements, applied to a support, the support having macropores.

[0040] In a preferred embodiment, the support has a mean pore diameter of at least 50 nm and a BET surface area of not more than 30 m²/g and the amount of the active metal is 0.01 to 30% by weight, based on the total weight of the catalyst.

[0041] In a further embodiment, a catalyst is used in which the amount of the active metal is 0.01 to 30% by weight, based on the total weight of the catalyst, and 10 to 50% of the pore volume of the support is formed by macropores having a pore diameter in the range of 50 nm to 10,000 nm and 50 to 90% of the pore volume of the support is formed by mesopores having a pore diameter in the range of 2 to 50 nm, the sum of the proportions of pore volumes being 100%.

[0042] In a further embodiment, the catalyst has 0.01 to 30% by weight, based on the total weight of the catalyst, of an active metal, applied to a support, the support having a mean pore diameter of at least 0.1 μm and a BET surface area of not more than 15 m²/g. Supports which may be used are in principle all supports which have macropores, i.e., supports which have exclusively macropores and those which also comprise mesopores and/or micropores in addition to macropores.

[0043] In principle, all metals of subgroup VIII of the Periodic Table of the Elements can be used as active metal. Platinum, rhodium, palladium, cobalt, nickel or ruthenium or a mixture of two or more thereof is preferably used as active metals, in particular ruthenium being used as active metal. Among the metals of subgroup I or VII of or subgroup I and VII of the Periodic Table of the Elements, all of which can in principle likewise be used, copper and/or rhenium are preferably employed.

[0044] In the context of the present application, the terms “macropores” and “mesopores” are used in the manner defined in Pure Appl. Chem., 45, page 79 (1976), namely as pores whose diameter is above 50 nm (macropores) or whose diameter is between 2 nm and 50 nm (mesopores).

[0045] The content of the active metal is in general 0.01 to 30% by weight, preferably 0.01 to 5% by weight, particularly preferably 0.1 to 5% by weight, based in each case on the total weight of the catalyst used.

[0046] The polyester of the presently claimed invention can be used as a lubricant in industrial oils. Industrial oils can be selected from the group consisting of light, medium and heavy duty engine oils, industrial engine oils, marine engine oils, crankshaft oils, compressor oils, refrigerator oils, hydrocarbon compressor oils, very low-temperature lubricating oils and fats, high temperature lubricating oils and fats, wire rope lubricants, textile machine oils, refrigerator oils, aviation and aerospace lubricants, aviation turbine oils, transmission oils, gas turbine oils, spindle oils, spin oils, traction fluids, transmission oils, plastic transmission oils, passenger car transmission oils, truck transmission oils, industrial transmission oils, industrial gear oils, insulating oils, instrument oils, brake fluids, transmission liquids, shock absorber oils, heat distribution medium oils, transformer oils, fats, chain oils, drilling detergents for the soil exploration, hydraulic oils, chain saw oil and gun, pistol and rifle lubricants.

[0047] The industrial oil may preferably comprises further additives such as polymer thickeners, viscosity index improvers, antioxidants, corrosion inhibitors, detergents, dispersants, demulsifiers, defoamers, dyes, wear protection additives, EP (extreme pressure) additives, AW (antiwear) additives and friction modifiers.

[0048] Further the industrial oil may comprise other base oils and/or co-solvents like mineral oils (Gr I, II or III oils), polyalphaolefins, alkyl naphthalenes, mineral oil soluble polyalkylene glycols, silicone oils, phosphate esters and/or other carboxylic acid esters.

[0049] Typical additives found in hydraulic oils include dispersants, detergents, corrosion inhibitors, antiwear agents, anti-foamants, friction modifiers, seal swell agents, demulsifiers, VI improvers, and pour point depressants.

[0050] Examples of dispersants include polyisobutylene succinimides, polyisobutylene succinate esters and Mannich Base ashless dispersants.

[0051] Examples of detergents include metallic alkyl phenates, sulfurred metallic alkyl phenates, metallic alkyl sulfonates and metallic alkyl salicylates.

[0052] Examples of anti-wear additives include organo borates, organo phosphites, organic sulfur-containing compounds, zinc dialkyl diithiophosphates, zinc diaryl ditriithiophosphates and phosphosulfurized hydrocarbons.

[0053] Examples of friction modifiers include fatty acid esters and amides, organo molybdenum compounds, molybdenum dialkylthiocarbamates and molybdenum dialkyldithiophosphates.

[0054] An example of an anti-foamant is polyisoxalane. Examples of rust inhibitors are polyoxyalkylene polyols, carboxylic acids or triazol components. Examples of VI improvers include olefin copolymers, polyalkylmethacrylates and dispersant olefin copolymers. An example of a pour point depressant is polyalkylmethacrylate.

[0055] The polyester of the presently claimed invention can be used as a lubricant in metalworking fluids.

[0056] Depending on the applications, e.g., straight oils (neat oils) or soluble oils, the metalworking fluid may contain applicable additives known in the art to improve the properties of the composition in amounts ranging from 0.10 to 40 wt. %. These additives include metal deactivators; corrosion inhibitors; antimicrobial; anticorrosion; emulsifying agents; coupling agents; extreme pressure agents; antifriction; antitrust agents; polymeric substances; anti-inflammatory agents; bactericides; antiseptics; antioxidant; chelating agents; pH regulators; antiwear agents including active sulphur antiwear additive packages; a metalworking fluid additive package containing at least one of the aforementioned additives.

[0057] Depending on the end-use applications, small quantities of additives such as anti-misting agents may be optionally added in an amount ranging from 0.05 to 5.0% by vol. in one embodiment and less than 1 wt. % in other embodiments. Limiting examples include rhodanum gum, hydrophobic and hydrophilic monomers, styrene or hydrocarbolyl-substituted styrene hydrophobic monomers and hydrophilic monomers, oil soluble organic polymers ranging in molecular weight (viscosity average molecular weight) from about 0.3 to over 4 million such as isotobutylene, styrene, alkyl methacrylate, ethylene, propylene, n-butylene vinyl acetate, etc. In one embodiment, polymethylmethacrylate or poly(ethylene, propylene, butylene or isobutylene) in the molecular weight range 1 to 3 million is used.

[0058] For certain applications, a small amount of foam inhibitors in the prior art can also be added to the composition in an amount ranging from 0.02 to 15.0 wt. %. Non-limiting examples include polydimethylsiloxanes, often trimethylsilyl terminated, alkyl polymethacrylates, polydimethylsiloxanes, an N-acylanimo acid having a long chain acyl group and/or a salt thereof, an N-alkylamino acid having a long
chain alkyl group and/or a salt thereof used concurrently with an alkyl-alkylene oxide and/or an acyalkylene oxide, acetylene diols and ethoxylated acetylene diols, silicones, hydrophobic materials (e.g. silica), fatty amides, fatty acids, fatty acid esters, and/or organic polymers, modified siloxanes, polyglycols, esterified or modified polyglycols, polycrystals, fatty acids, fatty acid esters, fatty alcohols, fatty alcohol esters, oxo-alcohols, fluorosurfactants, waxes such as ethylenebisstearamide wax, polyethylene wax, polypropylene wax, ethylenebisstearamide wax, and paraffinic wax. The foam control agents can be used with suitable dispersants and emulsifiers. Additional active foam control agents are described in “Foam Control Agents”, by Henry T. Kemer (Noyes Data Corporation, 1976), pages 125-162.

[0059] The metalworking fluid further comprises anti-friction agents including overbased sulfonates, sulfonated olefins, chlorinated paraffins and olefins, sulfonized ester olefins, amine terminated polyglycols, and sodium dioctyl phosphate salts. In yet another embodiment, the composition further comprises corrosion inhibitors including carboxylic/boric acid diamine salts, carboxylic acid amine salts, alkyl amine and alkyl amine borates.

[0060] The metalworking fluid further comprises oil soluble metal deactivators in an amount of 0.01 to 0.5 vol % (based on the final oil volume). Non-limiting examples include triazoles or thiadiazoles, specifically aryl triazoles such as benzotriazole and tolytriazole, alkyl derivatives of such triazoles, and benzothiadiazoles such as R(C_6H_5)_2N_2S where R is H or C_6H_4, or alkyl.

[0061] A small amount of at least an antioxidant in the range 0.01 to 1.0 weight % can be added. Non-limiting examples include antioxidants of the aminic or phenolic type or mixtures thereof, e.g., butylated hydroxytoluene (BHT), bis-2,6-di-t-butylphenol derivatives, sulfur containing hindered phenols, and sulfur containing hindered bisphenol.

[0062] The metalworking fluid further comprises 0.1 to 20 wt. % of at least an extreme-pressure agent. Non-limiting examples of extreme-pressure agent includes zinc dithiophosphate, molybdenum oxysulfide dithiophosphate, molybdenum amine compounds, sulfonated oils and fats, sulfonized fatty acids, sulfonated esters, sulfonated olefins, dihydrocarbyl polylsulfides, thiocarbamates, thioethers, and dialkyl thiophosphates.

[0063] In another embodiment, the presently claimed invention is related to a lubricant composition comprising:

A) at least one lubricating base oil,

B) at least one polyester obtainable by reacting a total mixture comprising phthalic acid, optionally in form of its esters or its anhydrides, and an alcohol mixture comprising 1-nonanol, mononemethyloctanol, dimethylheptanols and monomethylheptanols and subsequent hydrogenation of said total mixture, whereby the polyester has a dynamic viscosity at 20°C in the range of 40 to 62 mPa.s determined according to DIN 51562-1 and

C) lubricating oil additives.

[0067] For the sake of conciseness, any preferred embodiment that refers to the use of the invention described polyester also refers to the lubricant composition itself.

[0068] Preferably the lubricant composition comprises 0.1% by weight to 50% by weight of component A), 50% by weight to 50% by weight of component B), and 0.1% by weight to 50% by weight of component C).

[0069] In another embodiment, the lubricant composition preferably comprises 30% by weight to 90% by weight of component A), 0.1% by weight to 50% by weight of component B) and 0.1% by weight to 40% by weight of component C).

[0070] More preferably the lubricant composition comprises 50% by weight to 90% by weight of component A), 3.5% by weight to 45% by weight of component B) and 1.0% by weight to 30% by weight of component C).

[0071] Most preferably the lubricant composition comprises 60% by weight to 90% by weight of component A), 10% by weight to 25% by weight of component B) and 2.0% by weight to 20% by weight of component C).

[0072] The viscosity of the lubricant composition at 40°C is preferably from 60 to 140 mm²/s, more preferably from 70 to 130 mm²/s and most preferably from 80 to 120 mm²/s determined according to DIN 51562-1.

[0073] Preferably the lubricating base oil is hydrotreated mineral oil and/or synthetic hydrocarbon oil. Preferably the hydrotreated base oil is selected from the group consisting of hydrotreated naphthenic mineral oil, API base oil classification Group II and Group III hydrotreated paraffinic mineral oil. Preferably the synthetic hydrocarbon oil is selected from the group consisting of isoparaffinic synthetic oil, GTL synthetic oil and poly-α-olefin (PAO) belonging to API base oil classification Group IV.

[0074] Preferably the lubricating oil additives are selected from the group consisting of viscosity improvers, viscosity improvers, combustion improvers, corrosion and/or oxidation inhibiting agents, pour point depressing agents, extreme pressure agents, antioxidizing agents, antioxidants, detergents, dispersants, metal passivators.

[0075] Typical viscosity improvers are commercial acid-based viscosity improvers which have fatty acids as their main constituent and ester-based viscosity improvers which have as their main constituent ether modified fatty acids. These compounds may be used singly or in combinations of two or more kinds. The fatty acids used in these viscosity improvers are preferably those that have as their main constituent a mixture of unsaturated fatty acids of approximately 12 to 22 carbons, but preferably about 18 carbons, that is oleic acid, linoleic acid and linolenic acid.

[0076] Viscosity improvers include but are not limited to polyisobutenes, polymethacrylate acid esters, polyacylate acid esters, diene polymers, polyalkyl styrenes, alkoxyl conjugated diene copolymers, polyolefins and multifunctional viscosity improvers.

[0077] For point depressing agents are a particularly useful type of additive, often included in the lubricating oils described herein, usually comprising substances such as polymethacrylates, styrene-based polymers, crosslinked alkyl phenols, or alkyl naphthenales. See for example, page 8 of “Lubricant Additives” by C. V. Smallheer and R. Kennedy Smith (Lesius-Hilse Company Publishers, Cleveland, Ohio, 1967).

[0078] For instance, corrosion inhibiting agents, extreme pressure agents, and antioxidant agents include but are not limited to dithiophosphoric esters; chlorinated aliphatic hydrocarbons; boron-containing compounds including borate esters and molybdenum compounds.

[0079] Antifoam agents used to reduce or prevent the formation of stable foam include silicones or organic polymers. Examples of these and additional antifoam compositions are described in “Foam Control Agents”, by Henry T. Kemer (Noyes Data Corporation, 1976), pages 125-162. Additional antifoam agents can be selected, typically of the aromatic
amine or hindered phenol type. These and other additives which may be used in combination with the present invention are described in greater detail in U.S. Pat. No. 4,582,618 (column 14, line 52 through column 17, line 16, inclusive).

[0080] Dispersants are well known in the field of lubricants and include primarily what are sometimes referred to as “ashless” dispersants because (prior to mixing in a lubricating composition) they do not contain ash-forming metals, and they do not normally contribute any ash forming metals when added to a lubricant composition. Dispersants are characterized by a polar group attached to a relatively high molecular weight hydrocarbon chain.

[0081] One class of dispersant is Mannich bases. These are materials which are formed by the condensation of a higher molecular weight, alkyl substituted phenol, an alkylene polyamine, and an aldehyde such as formaldehyde and are described in more detail in U.S. Pat. No. 3,634,515. Another class of dispersant is high molecular weight esters. These materials are similar to Mannich dispersants or the succinimides described below, except that they may be seen as having been prepared by reaction of a hydrocarbyl acylating agent and a polyhydric aliphatic alcohol such as glycerol, pentaerythritol, or sorbitol. Such materials are described in more detail in U.S. Pat. No. 3,381,022. Other dispersants include polymeric dispersant additives, which are generally hydrocarbon-based polymers.

[0082] A preferred class of dispersants is the carboxylic dispersants. Carboxylic dispersants include succinimide dispersants, which are the reaction product of a hydrocarbyl substituted succinimide acylating agent with an organic hydroxy compound or, in certain embodiments, an amine containing at least one hydroxy attached to a nitrogen atom, or a mixture of said hydroxy compound and amine. The term “succinimide acylating agent” refers to a hydrocarbon-substituted succinic acid or succinic acid-producing compound. Such materials typically include hydrocarbyl-substituted succinic acids, anhydrides, esters (including half esters) and halides. Succinimide dispersants are more fully described in U.S. Pat. Nos. 4,234,435 and 3,172,892.

[0083] The amines which are reacted with the succinic acylating agents to form the carboxylic dispersant composition can be monoamines or polyamines. Polyamines include principally alkylene polyamines such as ethylene polyamines (i.e., ethylene diamine, triethylene tetramine, propylene diamine, decamethylene diamine, octamethylene diamine, di(heptamethylene) triamine, tripropylene tetramine, tetraethylene pentamine, trimethylene diamine, pentamethylene hexamine, di-(trimethylene) triamine. Higher homologues such as are obtained by condensing two or more of the above-illustrated alkylene amines likewise are useful. Tetraethylene pentamines is particularly useful.

[0084] Hydroxylalkyl-substituted alkylene amines, i.e., alkylene amines having one or more hydroxylalkyl substituents on the nitrogen atoms, likewise are useful, as are higher homologues obtained by condensation of the above-illustrated alkylene amines or hydroxy alkyl-sulfated alkylene amines through amino radicals or through hydroxy radicals.

[0085] The dispersants may be borated materials. Borated dispersants are well known materials and can be prepared by treatment with a borating agent such as boric acid. Typical conditions include treating the dispersant with boric acid at 100 to 150°C. or to 1: 1 C.

[0086] The amount of the dispersant in a lubricant composition, if present, will typically be 0.5 to 10 percent by weight, or 1 to 8 percent by weight, or 3 to 7 percent by weight. Its concentration in a concentrate will be correspondingly increased, to, e.g., 5 to 80 weight percent.

[0087] Detergents are generally salts of organic acids, which are often overbased. Metal overbased salts of organic acids are widely known to those of skill in the art and generally include metal salts wherein the amount of metal present exceeds the stoichiometric amount. Such salts are said to have conversion levels in excess of 100% (i.e., they comprise more than 100% of the theoretical amount of metal needed to convert the acid to its “normal” or “neutral” salt). They are commonly referred to as overbased, hyperbased or super-based salts and are usually salts of organic sulfur acids, organic phosphorus acids, carboxylic acids, phenols or mixtures of two or more of any of these. As a skilled worker would realize, mixtures of such overbased salts can also be used.

[0088] The overbased compositions can be prepared based on a variety of well-known organic acidic materials including sulfonic acids, carboxylic acids (including substituted salicylic acids), phenols, phosphonic acids, saligenins, sulfonates, and mixtures of any or two or more of these.

[0089] The basically reacting metal compounds used to make these overbased salts are usually an alkali or alkaline earth metal compound, although other basically reacting metal compounds can be used. Compounds of Ca, Ba, Mg, Na and Li, such as their hydroxides and alkoxydes of lower alkans are usually used. Overbased salts containing a mixture of ions of two or more of these metals can be used.

[0090] Overbased materials are generally prepared by reacting an acidic material (typically an inorganic acid or lower carboxylic acid, such as carbon dioxide) with a mixture comprising an acidic organic compound, a reaction medium comprising at least one inert, organic solvent (inert oil, naphtha, toluene, xylene, etc.) for said acidic organic material, a stoichiometric excess of a metal base, and a promoter.

[0091] The acidic material used in preparing the overbased material can be a liquid such as formic acid, acetic acid, nitric acid, or sulfuric acid. Acetic acid is particularly useful. Inorganic acidic materials can also be used, such as HCl, SO₂, SO₃, CO₂, or H₂S, e.g., CO₂ or mixtures thereof, e.g., mixtures of CO₂ and acetic acid.

[0092] The detergents generally can also be borated by treatment with a borating agent such as boric acid. Typical conditions include heating the detergent with boric acid at 100 to 150°C., the number of equivalents of boric acid being roughly equal to the number of equivalents of metal in the salt.

[0093] The amount of the detergent component in a lubricant composition, if present, will typically be 0.5 to 10 percent by weight, such as 1 to 7 percent by weight, or 1.2 to 4 percent by weight. Its concentration in a concentrate will be correspondingly increased, to, e.g., 5 to 65 weight percent.

[0094] Examples of metal passivators include, but are not limited to, tolyltriazole and its derivatives, and benzotriazole and its derivatives. When used, the metal passivators are typically present in the fluid composition in an amount of from 0.05 to 5, more typically from 0.05 to 2, parts by weight based on the total weight of the fluid composition.

[0095] The examples below illustrate the invention in further detail without being limiting.
EXAMPLES

A) Preparation of a Polyester of the Invention

A.1) Butene Dimerization

The butene dimerization was carried out continuously in an adiabatic reactor, composed of two subreactors (length: in each case 4 m, diameter: in each case 80 cm) with intermediate cooling at 30 bar. The starting product used was a raffinate II with the following makeup:

<p>| | |</p>
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>isobutane</td>
<td>2% by weight</td>
</tr>
<tr>
<td>n-butane</td>
<td>10% by weight</td>
</tr>
<tr>
<td>isobutene</td>
<td>2% by weight</td>
</tr>
<tr>
<td>1-butene</td>
<td>32% by weight</td>
</tr>
<tr>
<td>cis-2-butene</td>
<td>17% by weight</td>
</tr>
<tr>
<td>trans-2-butene</td>
<td>37% by weight</td>
</tr>
</tbody>
</table>

A continuously operated plant consisting of two tubular reactors connected in series (main reactor 160 ml, d. 12 mm, 20.5% 1-nonanol 20.8% 6-methyl-1-octanol

A.2) Hydroformylation and Hydrogenation

750 g of the octene mixture prepared according to section A.1 of the examples were reacted for 5 hours continuously, in an autoclave, with 0.13% by weight of dimethyl octacarbonyl CO$_2$ (CO)$_8$ as catalyst, with addition of 75 g of water, at 185°C and with a synthesis gas pressure of 280 bar at a ratio of H$_2$ to CO in the mixture of 60/40. Further material was injected to make up for the consumption of synthesis gas, seen in a fall-off of pressure in the autoclave. After releasing the pressure in the autoclave, the reaction discharge, with 10% strength by weight acetic acid, was freed oxidatively from the cobalt catalyst by introducing air, and the organic product phase was hydrogenated using Raney nickel at 125°C. and with a hydrogen pressure of 280 bar for 10 h. The isononanol fraction was separated off from the Cs paraffins and the high-boilers by fractional distillation of the reaction discharge.

A.2) The composition of the isononanol fraction was analyzed by gas chromatography. A specimen was trimethylsilylated in advance using 1 ml of N-methyl-N-trimethylsilyl trifluoroacetamide per 100 µl of specimen for 60 minutes at 80°C. Use was made of a Hewlett Packard Ultera 1 separating column of length 50 m and internal diameter of 0.32 mm, with a film thickness of 0.2 µm. Injector temperature and detector temperature were 250°C, and the oven temperature was 120°C. The split was 110 ml/min. The carrier gas used was nitrogen. The admission pressure was set at 200 kPa. 1 µl of the specimen was injected and detected by FID. The compositions determined for specimens by this method (percentage by gas chromatogram area) were as follows:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11.0%</td>
<td>1-ocanool</td>
</tr>
<tr>
<td>20.8%</td>
<td>6-methyl-1-octanol</td>
</tr>
</tbody>
</table>

B) Esterification

The density of this isononanol mixture was measured at 20°C as 0.8326, and the refractive index $n_D^{20}$ as 1.4353. The boiling range at atmospheric pressure was from 204 to 209°C.

A.3) Esterification

In the third process step, 865.74 g of the isononanol fraction obtained in process step 2 (20% excess based on phthalic anhydride) were reacted with 370.30 g of phthalic anhydride and 0.42 g of isopropyl butyl titanate as catalyst in a 21 autoclave with $N_2$ sparging (10 l/h) with a stirring speed of 500 rpm and a reaction temperature of 230°C. The water of reaction formed was removed continuously from the reaction mixture with the $N_2$ stream. The reaction time was 180 minutes.

The isononanol excess was subsequently distilled off under a reduced pressure of 50 mbar. 1000 g of the crude polyester were neutralized with 150 ml of 0.5% strength aqueous sodium hydroxide solution, by stirring at 80°C for 10 minutes. This gave a two-phase mixture having an upper organic phase and a lower aqueous phase (waste liquor comprising hydrolyzed catalyst). The aqueous phase was removed and the organic phase was washed with twice 200 ml of H$_2$O. For further purification, the neutralized and washed polyester was stripped with steam at 180°C and a reduced pressure of 50 mbar for 2 hours. The purified polyester was then dried at 150°C.50 mbar for 30 minutes by passage of an $N_2$ stream (2 l/h), then stirred with activated carbon for 5 minutes, and filtered off on a suction filter with Supra-Theoretik 5 filter aid (temperature 80°C).

The resultant polyester possesses a density of 0.973 g/cm³, a viscosity of 73.0 mPa*s and a refractive index $n_D^{20}$ of 1.4853.

A.4) Hydrogenation of the Ester

A meso/macroporous aluminum oxide support in the form of 4 mm extrudates, possessing a BET surface area of 228 m²/g and a pore volume of 0.45 ml/g, was impregnated with an aqueous ruthenium(III) nitrate solution having a concentration of 0.8% by weight. 0.15 ml/g (approximately 33% of the total volume) of the pores of the support possessed a diameter in the range from 50 nm to 10,000 nm, and 0.30 ml/g (approximately 67% of the total pore volume) of the pores of the support had a pore diameter in the range from 2 to 50 nm. The solution volume taken up by the support in the course of the impregnation corresponded approximately to the pore volume of the support used. The support impregnated with the ruthenium(III) nitrate solution was subsequently dried at 120°C and activated (reduced) in a stream of water at 200°C. The catalyst thus produced contained 0.5% by weight of ruthenium, based on the weight of the catalyst. A continuously operated plant consisting of two tubular reactors connected in series (main reactor 160 ml, d$_{internal}$=12 mm,
l=1400 mm, and postreactor 100 ml, d_postreactor=12 mm, l=1000 mm) was charged with the catalyst described in the preparation example (main reactor 71.5 g, postreactor 45.2 g). The main reactor was operated with circulation in trickle mode (liquid hourly space velocity 12 m/h), the postreactor in straight pass in liquid phase mode. The phthalic ester prepared in process step 3 was pumped through the reactor cascade (feed 66 g/h) with pure hydrogen at an average temperature of 128° C. in the main reactor and 128° C. in the postreactor, and with a pressure of 200 bar. The catalyst hourly space velocity in the main reactor was 0.6 kg phthalic ester/batch. Analysis of the reaction discharge by gas chromatography showed that >99.9% of the phthalic ester had been converted.

[0111] The resultant polyester possesses a density of 0.936 g/cm³, a viscosity of 47 mPa*s at 20° C. determined according to DIN 51562-1 and a refractive index nD 20° of 1.462.

[0112] B) Cloud Point Measurement

[0113] The cloud point of the ester according to example A.4 was determined to be -80° C. according to DIN ISO 3015.

[0114] C) Testing of Compatibility with Sealing Material

[0115] The seal compatibility test with sealing material acrylonitrile-butadiene-copolymer was performed at 100° C. for 168 hours according to the standard method ISO 1817 in the presence of the ester as obtained under A.4.

[0116] The sealing material showed a volume change of +33.3% (expansion).

[0117] D) TABLE 1

<table>
<thead>
<tr>
<th>Lubricant Formulations A and B (all values in weight-%)</th>
<th>Formulation A with DIDA</th>
<th>Formulation B with Ester according to Example A.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAO 6 (Nexvax® R: 2006, polyalphaolefin, obtainable from Nynas, Belgium)</td>
<td>52.0%</td>
<td>52.0%</td>
</tr>
<tr>
<td>DIDA</td>
<td>10.0%</td>
<td>—</td>
</tr>
<tr>
<td>Ester according to Example A.4</td>
<td>—</td>
<td>10.0%</td>
</tr>
<tr>
<td>Thickener (Lubrirol® R: 8406, polyisobutylene, available from Lubrizol)</td>
<td>13.0%</td>
<td>13.0%</td>
</tr>
<tr>
<td>Thickener (Lubrihol® R: 8407 from Lubrizol)</td>
<td>13.0%</td>
<td>13.0%</td>
</tr>
<tr>
<td>Additives (Angiolon® R: 6004, additive package available from Lubrizol)</td>
<td>12.0%</td>
<td>12.0%</td>
</tr>
<tr>
<td>Viscosity at 40° C. DIN 51562-1</td>
<td>113.8 mm²/s</td>
<td>123.8 mm²/s</td>
</tr>
<tr>
<td>Viscosity at 100° C. DIN 51562-1</td>
<td>16.7 mm²/s</td>
<td>17.0 mm²/s</td>
</tr>
<tr>
<td>Viscosity index (VI) ASTM D 2270</td>
<td>160</td>
<td>150</td>
</tr>
<tr>
<td>Density at 15° C. DIN 51757</td>
<td>0.8660 g/ml</td>
<td>0.8686 g/ml</td>
</tr>
<tr>
<td>Cloud Point DIN ISO 3015</td>
<td>-32.0° C.</td>
<td>&lt;-80.0° C.</td>
</tr>
</tbody>
</table>

[0118] DIDA is commercially available for example as Synative® ES DIDA from BASF SE, Ludwigshafen.

[0119] The seal compatibility test with sealing material acrylonitrile-butadiene-copolymer was performed at 100° C. for 168 hours according to the standard method ISO 1817 in the presence of formulation A and formulation B, respectively.

[0120] The sealing material showed a volume change of +12.0% (expansion) in the presence of formulation A and a volume change of 12.6% (expansion) in the presence of formulation B.

1. Use of a polyester obtainable by reacting a total mixture comprising phthalic acid, optionally in form of its esters or its anhydrides, and an alcohol mixture comprising 1-nonenol, monomethyloctanol, dimethylheptanols and monooctylphthalate and subsequent hydrogenation of said total mixture, whereby the polyester has a dynamic viscosity at 20° C. in the range of 40 to 64 mPa*s determined according to DIN 51562-1, as lubricant.

2. The use according to claim 1, characterized in that the polyester has a dynamic viscosity at 20° C. in the range of 42 to 62 mPa*s determined according to DIN 51562.

3. The use according to claim 1 or 2, characterized in that the alcohol mixture contains a proportion of 25% by weight to 55% by weight monomethyloctanols, related to the overall weight of the alcohol mixture.

4. The use according to one or more of claims 1 to 3, characterized in that the alcohol mixture contains a proportion of 10% by weight to 30% by weight dimethylheptanols, related to the overall weight of the alcohol mixture.

5. The use according to one or more of claims 1 to 4, characterized in that the alcohol mixture contains a proportion of 6% by weight to 16% by weight 1-nonenol, 25% by weight to 55% by weight monomethyloctanols, 10% by weight to 30% by weight dimethylheptanols and 7% by weight to 15% by weight monoethylheptanols, related to the overall weight of the alcohol mixture.

6. The use according to one or more of claims 1 to 5, characterized in that the alcohol mixture is present in a molar ratio in the range of 1:1 to 2:1 in relation to phthalic acid, optionally in form of its esters or its anhydrides.
7. A lubricant composition comprising
A) at least one lubricating base oil,
B) at least one polyester obtainable by reacting a total mixture comprising phthalic acid, optionally in form of its esters or its anhydrides, and an alcohol mixture comprising 1-nananol, monomethyloctanol, dimethylheptanols and monoethylheptanols and subsequent hydrogenation of said total mixture, whereby the polyester has a dynamic viscosity at 20 °C. in the range of 40 to 62 mPa·s determined according to DIN 51562-1 and
C) lubricating oil additives.

8. The lubricant composition according to claim 7, characterized in that the lubricating base oil is hydrotreated mineral oil and/or synthetic hydrocarbon oil.

9. The lubricant composition according to claim 8, characterized in that the hydrotreated mineral oil is selected from the group consisting of hydrotreated naphthenic mineral oil, API base oil classification Group II and Group III hydrotreated paraffinic mineral oil.

10. The lubricant composition according to claim 8, characterized in that the synthetic hydrocarbon oil is selected from the group consisting of isoparaffinic synthetic oil, GTL synthetic oil and poly-α-olefin (PAO) belonging to API base oil classification Group IV.

11. The lubricant composition according to one or more of claims 7 to 10, characterized in that the polyester has a dynamic viscosity at 20 °C. in the range of 42 to 61 mPa·s determined according to DIN 51562-1.

12. The lubricant composition according to one or more of claims 7 to 11, characterized in that the alcohol mixture contains a proportion of 25% by weight to 55% by weight monomethyloctanols, related to the overall weight of the alcohol mixture.

13. The lubricant composition according to one or more of claims 7 to 12, characterized in that the alcohol mixture contains a proportion of 10% by weight to 30% by weight dimethylheptanols, related to the overall weight of the alcohol mixture.

14. The lubricant composition according to one or more of claims 7 to 13, characterized in that the alcohol mixture contains a proportion of 6% by weight to 16% by weight 1-nananol, 25% by weight to 55% by weight monomethyloctanols, 10% by weight to 30% by weight dimethylheptanols and 7% by weight to 15% by weight monomethylheptanols, related to the overall weight of the alcohol mixture.

15. The lubricant composition according to claim 7, characterized in that the lubricating oil additives are selected from the group consisting of lubricity improvers, viscosity improvers, combustion improvers, corrosion and/or oxidation inhibiting agents, pour point depressing agents, extreme pressure agents, antiwear agents, antifoam agents, dispersants, antioxidants and metal passivators.

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