



US 20160201001A1

(19) **United States**(12) **Patent Application Publication**
FACKLER(10) **Pub. No.: US 2016/0201001 A1**(43) **Pub. Date: Jul. 14, 2016**(54) **ADDITIVE FOR OIL-BASED LUBRICANTS
HAVING IMPROVED EXTREME PRESSURE
PROPERTIES****Publication Classification**(71) Applicant: **TERRALUB GMBH,**
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§ 371 (c)(1),

(2) Date: **Feb. 18, 2016**(30) **Foreign Application Priority Data**

Aug. 21, 2013 (DE) 10 2013 109 064.8

(51) **Int. Cl.****C10M 141/08** (2006.01)**C10M 133/06** (2006.01)**C10M 127/02** (2006.01)**C10M 135/36** (2006.01)(52) **U.S. Cl.**CPC **C10M 141/08** (2013.01); **C10M 135/36**
(2013.01); **C10M 133/06** (2013.01); **C10M**
127/02 (2013.01)

(57)

ABSTRACT

The present invention relates to a novel additive for oil-based lubricants having improved extreme-pressure properties, to a method for producing said novel additive, to oil-based lubricants containing said novel additive and to uses of said novel additive.

ADDITIVE FOR OIL-BASED LUBRICANTS HAVING IMPROVED EXTREME PRESSURE PROPERTIES

[0001] The present invention relates to a novel additive for oil-based lubricants having improved extreme pressure properties, to a process for producing this novel additive, to oil-based lubricants comprising this novel additive and to uses of this novel additive.

[0002] The phenomena of friction, lubrication and wear are of enormous practical significance. Attempts are made to reduce the major losses of material and energy which are caused by wear by careful material selection, surface coating, surface hardening and lubrication. One of the most important demands on a lubricant is for it to give effective surface protection of the materials. Various friction phenomena occur in unlubricated metal surfaces which move against one another under stress. In many cases, abrasive wear extending as far as microscale wear of the workpieces is observed. The use of lubricants serves to distinctly reduce material wear by abrasion, which accompanies dry friction.

[0003] The finding that pure base oils, whether they are mineral oils or synthetic oils, cannot assure effective protection of highly mechanically stressed surfaces led to the addition of additives as early as the turn of the last century. It is only these additives that help the lubricant oil to attain the desired use properties. The aim is thus to enhance positive properties and to eliminate or minimize unwanted properties. The amount of additives mixed in varies according to the application from a few ppm up to concentrations of 20%.

[0004] As well as the control of the physical properties of a lubricant oil, for instance the viscosity as a hydrodynamic parameter, it is possible to chemically modify the lubricant and surface. One of the most important demands on a lubricant additive is the surface protection of the materials, which prevents or at least greatly reduces abrasive wear and microscale wear between metal surfaces. This property is assured by what are called antiwear (AW) and extreme pressure (EP) active ingredients.

[0005] Frequently, especially in steelworking, mid-chain chloroparaffins (C14-C17) are still being used as extreme pressure (EP) additives in spite of considerable concerns with regard to the environment and health. Because of these negative properties of chloroparaffins, there is a considerable need for substitutes that are not of ecological and toxicological concern for the various fields of use. In the lubricants sector, however, it has not been possible to entirely displace chloroparaffins from many applications, since they have excellent performance, especially at extreme pressures. The main field of use for chloroparaffins is forming technology (deep drawing, thread forming, etc.).

[0006] Owing to environmental relevance, chloroparaffins have partly been replaced by more ecologically acceptable zinc compounds, for example by zinc dialkyldithiophosphates, zinc complexes of alkyl dithiophosphates (RO)2P(S)SH having the general empirical formula $Zn[(RO)_2PS_2]_2$. These compounds are among the layer-forming active ingredients, although the components that are actually active are not the complexes themselves but the reaction or breakdown products which arise in frictional processes under stress. Regrettably, these zinc compounds by no means offer the EP performance of the chloroparaffins.

[0007] Further known lubricant additives are thiadiazoles, which are known as additives having good separating action and high pressure absorption capacity (EP) and additionally

offer very good corrosion protection, especially in the case of nonferrous metals. The monomeric thiadiazoles—also referred to as dimercaptothiadiazole—are therefore used mainly as nonferrous metal deactivators, as described in EP2228425A1, and are sold, for example, under the “Additin RC8210” or “Additin RC 5201” names by RheinChemie Rheinau GmbH. The monomeric thiadiazoles are generally colorless clear liquids which are soluble in oily hydrophobic media. However, the EP properties in the case of monomeric thiadiazole are still inferior to those of the abovementioned zinc compounds, such as zinc dithiophosphate or zinc dithiocarbamate.

[0008] Dimeric 2,5-dimercapto-1,3,4-thiadiazole is commercially available under the “Vanlube 829” name from the Vanderbilt Company, USA, and unlike the monomers has very good EP properties. It is a compound which finds use mainly in greases or pastes, but not in liquid oily (hydrophobic) media. The reason for the very restricted use is that the pulverulent substance is insoluble in hydrophobic systems and cannot be dispersed effectively because of the relatively high density (2.09 g/cm³). However, a maximum fineness of distribution of 2,5-dimercapto-1,3,4-thiadiazole in the matrix is a prerequisite for effective performance.

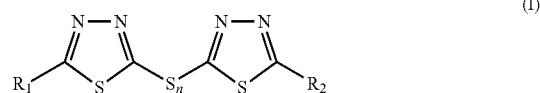
[0009] In summary, it can thus be stated that the lubricant additives known from the prior art are either of ecological or toxicological concern, have inadequate EP performance or cannot be used viably in liquid oily (hydrophobic) media.

[0010] It is thus an object of the present invention to develop a lubricant system which avoids the abovementioned disadvantages of the prior art.

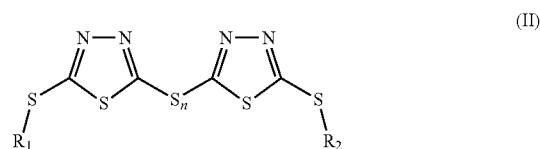
[0011] This object is achieved in accordance with the invention by a process for producing a lubricant additive, which is characterized in that

a)

[0012] i) a dimeric thiadiazole compound, especially a bis(2-alkyl-1,3,4-thiadiazolyl) 5,5'-disulfide derivative of the formula (I)



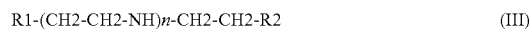
[0013] and/or a dimeric 2,5-dimercapto-1,3,4-thiadiazolethiol derivative of the formula (II)



[0014] where n in the formulae (I) and (II) is 1 or 2 and

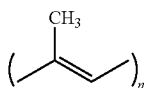
[0015] R1 and R2 are each independently hydrogen, linear or branched alkyl groups having 1 to 12 carbon atoms, especially thioalkyl groups (—SR) having 1 to 12 carbon atoms, aromatic radicals or heteroaromatic radicals,

[0016] ii) is dissolved in a polyamine or polyamine derivative of the formula (III)



[0017] where n in formula (III) is an integer from 1 to 15, especially an integer from 3 to 8, and R1 and R2 are each independently hydrogen, $-NH_2$, linear or branched alkyl groups having 1 to 12 carbon atoms or a modified or unmodified succinimide group, and

[0018] iii) a compound of the formula (IV)



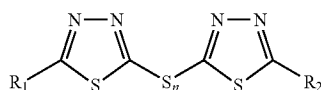
(IV)

[0019] in which n is an integer from 1 to 8, especially an integer from 3 to 8, preferably 6, is added to the solution obtained,

[0020] or

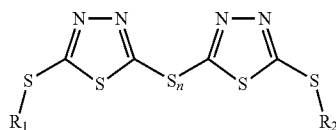
b)

[0021] i) a dimeric thiadiazole compound, especially a bis(2-alkyl-1,3,4-thiadiazolyl) 5,5'-disulfide derivative of the formula (I)



(I)

[0022] and/or a dimeric 2,5-dimercapto-1,3,4-thiadiazolethiol derivative of the formula (II)



(II)

[0023] where n in the formulae (I) and (II) is 1 or 2 and

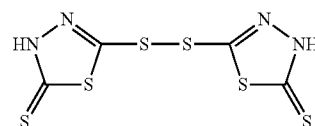
[0024] R1 and R2 are each independently hydrogen, linear or branched alkyl groups having 1 to 12 carbon atoms, especially thioalkyl groups ($-SR$) having 1 to 12 carbon atoms, aromatic radicals or heteroaromatic radicals,

[0025] ii) is dissolved in a polyol, especially a polyether polyol having a high propylene oxide content, i.e. having a low ethyl oxide/propylene oxide ratio, and/or a triglyceride having a hydroxy fatty acid component, and

[0026] iii) a hydrophobic phenol derivative and/or unsaturated fatty alcohol is added to the solution obtained.

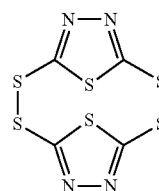
[0027] The component process steps a) ii) and a) iii), or b) ii) and b) iii), can be combined if desired to give one step in each case.

[0028] A dimeric thiadiazole compound usable with preference in a) i) or b) i) is 5,5'-dithiobis(1,3,5-thiadiazole-2-thiol) with R1 and R2=H (CAS no.: 72676-55-2) which is shown in formula (IIa):



(IIa)

[0029] A dimeric thiadiazole compound likewise usable in accordance with the invention is bis[2,5-dithio-1,3,4-thiadiazole] (formula VIII), which is described, for example, in EP1702918 A2 to RHEIN-CHEMIE RHEINAU GmbH.



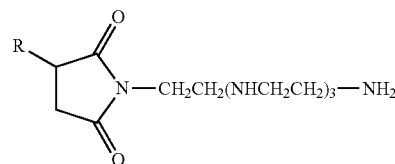
(VIII)

[0030] Also usable in accordance with the invention are compounds of the formulae (I) and (II) wherein the R radicals are alkyl or thioalkyl groups. With increasing chain length of the alkyl groups on R1 and R2, the solubility in hydrophobic media increases stepwise. These side groups make an ever greater contribution to reducing the friction value with growing chain length, but can have an adverse effect on the EP properties. The load-bearing capacity tends to increase with the number of sulfur atoms in the molecule, and the solubility in hydrophobic media tends to decrease at the same time.

[0031] In order to combine high load-bearing capacity with simultaneously high lubricity (friction value reduction), it is possible for the person skilled in the art, according to the requirement, to combine different dimeric thiadiazole compounds of the formulae (I) and (II) with one another as appropriate.

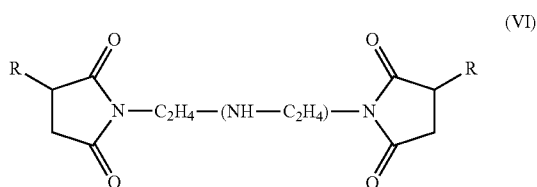
[0032] The compounds of the formulae (I) and (II) are used in accordance with the invention in alternative a) with a proportion by weight of 4% to 13%, preferably 8% to 10%.

[0033] Polyamines or polyamine derivatives of the formula (III) which are preferred in accordance with the invention are those which, rather than R1 or R2, independently contain a succinimide group. Particular preference is given to the monosuccinimide derivative having CAS no. 67762-72-5, which is shown in the formula (V),



(V)

in which R is a polyisobutylene radical having a molecular weight in the range of 500-2500. Particular preference is likewise given to the bissuccinimide derivative having CAS no. 84605-20-9, which is shown in the formula (VI),



in which n is an integer from 1 to 8 and R a polyisobutylene radical having a molecular weight in the range of 500-2500.

[0034] A modification of succinimide-polyamine compounds which is likewise usable in accordance with the invention is described in U.S. Pat. No. 6,569,819, which is hereby fully incorporated by reference. Further solvents suitable in accordance with the invention for dimeric thiadiazoles are polyamine compounds containing terminal (R1/R2) phenyl groups or heterocyclic ring compounds, such as thiadiazoles or succinimide in combination with thiadiazoles. Compounds of this kind are described, for example, in U.S. Pat. No. 5,597,785, which is hereby fully incorporated by reference.

[0035] The compounds of the formula (III) are used in accordance with the invention, in alternative a), with a proportion by weight of 30% to 95%, preferably 40% to 60%, any desired mixtures of compounds of the formulae (III), (IV) and (V), preferably (IV) and (V), being possible.

[0036] Advantageously, the types of polyamine-based compounds mentioned are not a matter of ecological, toxicological or health concern.

[0037] Polyamines, and also the corresponding succinimide derivatives, have a honey-like consistency at room temperature, become mobile when heated above 70° C. and are then capable of gradually dissolving dimeric 2,5-dimercapto-1,3,4-thiadiazoles without residue. Alternative a) of the process of the invention is therefore preferably conducted at a temperature in the range from about 70° C. to about 140° C., more preferably at a temperature in the range from about 80° C. to about 130° C., most preferably at a temperature in the range from about 80° C. to about 120° C. At temperatures between 120° C. and 140° C.—higher temperatures may lead to decomposition reactions under some circumstances—brown-red solutions are formed, but these are not usable any further after cooling because of a rubber-like consistency.

[0038] The dissolution capacity of the polyamine derivatives mentioned, the intense color of the solutions and the significant increase in viscosity indicate a marked interaction between dimeric thiadiazoles and polyamines. It is apparent that adducts are formed, and these cannot be distributed homogeneously in oily hydrophobic media at a relatively high active ingredient concentration as required for attainment of the desired EP properties, just like the corresponding dimeric thiadiazoles themselves.

[0039] It has been found that, surprisingly, compounds of the formula (IV), namely linear compounds having a number of non-conjugated double bonds as occur, for example, in farnesene, lycopene or squalene, are suitable for keeping these adducts in permanently liquid form even at room temperature. It can be assumed that steric mechanisms play a major role in keeping the adducts separate in a spatially effective manner even at high active ingredient concentrations. The use of compounds of the formula (IV) as a further medium in component step a) ii) is therefore an essential constituent of the present invention.

[0040] Among the compounds of the formula (IV), squalene ($n=6$) is particularly suitable in accordance with the invention because of its favorable consistency (viscosity) and its relatively low vapor pressure. Also suitable are molecules having relatively short chain lengths, but the limiting factor for some applications is the significantly increasing vapor pressure or odor.

[0041] Higher chain lengths ($n \geq 9$) lead to solids, which cannot be used in accordance with the invention, at least at room temperature.

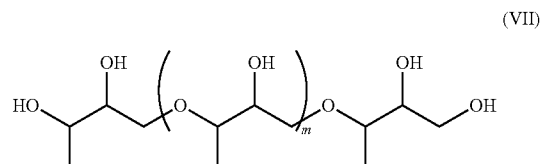
[0042] The compounds of the formula (IV) are used in accordance with the invention in alternative a) with a proportion by weight of 10% to 60%, preferably 30% to 50%.

[0043] With squalene in conjunction with polyamine derivatives, it is thus possible to prepare additive solutions having an active ingredient content of more than 10% by weight, the consistency of which remains within the manageable liquid range from 10° C. upward and which give clear solutions in hydrophobic esters (vegetable oils or synthetic esters) as base oil in any ratio which is viable from the point of view of the person skilled in the art.

[0044] In pure, entirely nonpolar oils such as paraffin or hydrophobic polyglycol, however, this additive is unstable; the active ingredient gradually precipitates out. Therefore, it does not have unrestricted usability in this form in practice.

[0045] The present invention therefore further provides the process according to alternative b).

[0046] Polyols usable with preference in component process step b) ii) are, for example, hydrophobic polyether polyols of the formula (VII) having an ethylene oxide/propylene oxide ratio < 1



where m in the formula (VII) is an integer from 6 to 14, especially from 6 to 10. Polyols usable with particular preference have an ethylene oxide/propylene oxide ratio (EO/PO ratio) of < 0.5 .

[0047] Triglycerides with a hydroxy fatty acid component usable with preference in component process step b) ii) are selected from those obtainable from renewable raw materials, especially from ricinoleic acid (12-(R)-hydroxy-9-cis-octadecenoic acid), lesquerolic acid (14-(R)-hydroxy-11-cis-eicosenoic acid), 9-(S)-hydroxy-10,12-cis,cis-octadecadienoic acid (available from the oil of the seeds of *Dimorphotheca pluvialis*), phloionic acid (meso-9,10-dihydroxyocta-decanoic acid) and aleuritic acid.

[0048] Particular preference is given in accordance with the invention to castor oil, which typically contains about 85% to 92% ricinoleic acid.

[0049] The compounds of the formula (I) or (II) are used in accordance with the invention, in alternative b), with a proportion by weight of 3% to 6%, preferably 4% to 5%.

[0050] The polyols and/or triglycerides with a hydroxy fatty acid component are used in accordance with the invention, in alternative b), with a proportion by weight of 40% to 96%, preferably 50% to 80%.

[0051] Clear yellow solutions are formed within the temperature range from about 100° C. to about 140° C. Alternative b) of the process of the invention is therefore preferably conducted at a temperature in the range from about 100° C. to about 140° C., more preferably at a temperature in the range from about 120° C. to about 140° C.

[0052] The saturation concentration for 5,5'-dithiobis(1,3,5-thiadiazole-2-thiol) is about 4% to 5% by weight. After cooling, in the case of a high active ingredient concentration, a jelly-like mass can form, which can be dissolved very well, i.e. in a broad mixing ratio, even in hydrophobic polyglycol.

[0053] Very concentrated additive solutions have a gel-like consistency especially after standing for a prolonged period (about 1 month). The color is clearly yellow. With castor oil, it is possible to produce a maximum of about 5% by weight solutions, which are of particularly good suitability for the additization of hydrophobic polyglycol types.

[0054] In contrast to the case of the lubricant additive obtainable according to a), it is also possible in the case of the additive obtainable according to b) to add relevant amounts of additive in paraffin-based media without precipitation. The nonpolar media here should preferably contain at least 10% by volume of polyglycol or castor oil in order to attain the requisite stability.

[0055] Hydrophobic phenol derivatives usable with preference in component process step b) iii) are selected from anacardic acid, cardol, cardanol.

[0056] Unsaturated fatty alcohols usable with preference in component process step b) iii) are selected from hexadecenol, octadecenol.

[0057] The hydrophobic phenol derivatives and/or unsaturated fatty alcohols are used in accordance with the invention, in alternative b), with a proportion by weight of 40% to 96%, preferably 50% to 80%.

[0058] By precipitation reactions, it was possible to detect, both in the case of the additives obtainable according to a) and in the case of those obtainable according to b), that no chemical conversions took place with regard to the starting materials.

[0059] It is also possible to produce stable sols extending as far as stable microfine dispersions from both systems with appropriate dispersing additions, especially with additional polyamines and derivatives thereof.

[0060] The following examples illustrate the invention, but without restricting it thereto:

EXAMPLES

Example 1

[0061] A dimeric thiadiazole having a proportion by weight of 4% is distributed homogeneously into a mixture having a proportion by weight of up to 50% rapeseed oil and a further proportion by weight of up to 50% dialkyl-succinimide dispersant with stirring at a maximum of 140°, in the course of which a dark red liquid gradually forms. Further additions such as benzotriazole (as preservative, not as nonferrous metal deactivator) are added with a proportion by weight of up to 0.5%. After cooling, a stable viscous liquid is obtained, into which is mixed a base oil based on rapeseed oil up to a proportion by weight of 5%.

[0062] For comparison with zinc alkyldithiophosphate, an experiment was conducted with a four-ball apparatus. The base oil used for all the additives mentioned was Flexon 845 ISO VG 32 hydraulic base oil (available from Esso). It was

found that the thiadiazole (dimer) additive gave the best values at comparable concentrations. In the case of zinc alkylphosphate, the good load and welding load values were between 1600 N and 1700 N, and in the case of thiadiazole (dimer) between 2100 N and 2300 N.

Example 2

[0063] A flask is charged with a proportion of 60% squalene, 30% polyisobutylenesuccinimide (CAS no. 84605-20-9) and about 10% dimeric 2,5-dimercapto-1,3,4-thiadiazole (CAS no. 72676-55-2), and heated to about 135° C. The thiadiazole is dissolved completely to form a red-brown liquid. As a further addition, preservatives are added thereto. Cooling leaves a readily manageable viscous liquid, which can be used as EP additive.

[0064] This additive was added to the Flexon 845 ISO VG 32 hydraulic oil (available from Esso) in different concentrations, and the samples were subjected to a four-ball test. The results are recorded in the following table:

Additive concentration in Flexon 845 ISO VG 32	1.00%	2.50%	5.0%
Appearance	clear solution	clear solution	clear solution
Four-ball test (ASTM D 4172) 1 h, 75° C., 400 N, 1200 rpm			
Wear diameter (mm)	0.50	0.68	0.69
Four-ball test (ASTM D 2783) 10 s, 25° C., 1800 rpm			
Good load in N	1800	2200	3000
Welding load in N	2000	2400	3200

Example 3

[0065] 96% castor oil and 4% by weight of dimeric 2,5-dimercapto-1,3,4-thiadiazole (CAS no.: 72676-55-2) are heated to 140° C. in a flask, in the course of which the thiadiazole dissolves gradually. This forms a yellow transparent liquid, to which preservative is added while it is in the hot state. After cooling, the mixture can be used as additive to polyglycol-based (hydrophobic) lubricants, or else as anti-corrosive for nonferrous metals.

[0066] Copper corrosion was measured with different additization of Emkarox VG126 polyglycol (from Croda).

[0067] The results of the corrosion measurement are as follows:

Emkarox VG126 with additive	2.5% additive	5.0% additive	7.0% additive
Copper corrosion (ASTM D 130)			
100° C., 24 hours	1b	1b	1b

Example 4

[0068] Example of the preparation of a thiadiazole solution with the aid of phosphoric esters:

[0069] 200 mL of tributoxymethyl phosphate (AW11 Schafer Chemie) and 270 mL of paraffin (of low viscosity) are heated

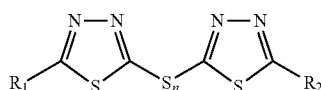
to 90° C. in a round-bottom flask. 40 g of dimeric thiadiazole are added in several portions until a clear solution forms. In order to assure storage life (bacterial infestation), a small amount (in the permille range) of benzotriazole which has been dissolved in a small amount of tributoxyalkyl phosphate beforehand is stirred into the still-hot solution. After cooling, the solution is usable.

[0070] It dissolves in any ratio in paraffin or else in mineral oil.

[0071] The invention further provides a lubricant additive obtainable by the process of the invention.

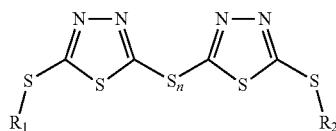
[0072] The invention further provides a lubricant additive comprising

[0073] I. a dimeric thiadiazole compound, especially a bis (2-alkyl-1,3,4-thiadiazolyl) 5,5'-disulfide derivative of the formula (I)



(I)

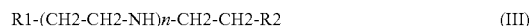
[0074] and/or a dimeric 2,5-dimercapto-1,3,4-thiadiazolethiol derivative of the formula (II)



(II)

[0075] where n in the formulae (I) and (II) is 1 or 2 and R1 and R2 are each independently hydrogen, linear or branched alkyl groups having 1 to 12 carbon atoms, especially thioalkyl groups (—SR) having 1 to 12 carbon atoms, aromatic radicals or heteroaromatic radicals,

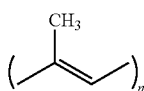
[0076] II. a polyamine or polyamine derivative of the formula (III)



[0077] where n in formula (III) is an integer from 1 to 15, especially an integer from 3 to 8, and

[0078] R1 and R2 are each independently hydrogen, —NH2, linear or branched alkyl groups having 1 to 12 carbon atoms or a modified or unmodified succinimide group, and

[0079] III. a compound of the formula (IV)

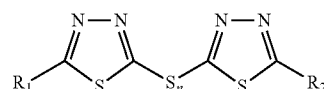


(IV)

[0080] in which n is an integer from 1 to 8, especially an integer from 3 to 8, preferably 6.

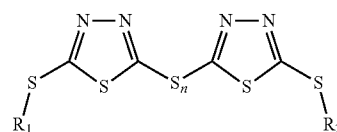
[0081] The invention further provides a lubricant additive comprising

[0082] I. a dimeric thiadiazole compound, especially a bis (2-alkyl-1,3,4-thiadiazolyl) 5,5'-disulfide derivative of the formula (I)



(I)

[0083] and/or a dimeric 2,5-dimercapto-1,3,4-thiadiazolethiol derivative of the formula (II)



(II)

[0084] where n in the formulae (I) and (II) is 1 or 2 and R1 and R2 are each independently hydrogen, linear or branched alkyl groups having 1 to 12 carbon atoms, especially thioalkyl groups (—SR) having 1 to 12 carbon atoms, aromatic radicals or heteroaromatic radicals,

[0085] II. a polyol, especially a polyether polyol having a high propylene oxide content, i.e. having a low ethyl oxide/propylene oxide ratio, and/or a triglyceride having a hydroxy fatty acid component, and

[0086] III. a hydrophobic phenol derivative and/or unsaturated fatty alcohol.

[0087] The proportions by weight of the constituents of the additives of the invention correspond to those specified for the production process.

[0088] The invention further provides a lubricant, especially a lubricant oil, comprising an additive of the invention, preferably in a concentration of 0.2% by weight to 10% by weight.

[0089] The invention further provides for the use of an additive of the invention in lubricants, especially for slide bearings, roller bearings, gears, chains, fine mechanics, slide-ways, motors, hydraulics, tools, machines, metalworking operations, material-removing metalworking and cold forming. Accordingly, lubricants of the invention are distinguished by the field of use, for example as machine lubricant oils, cylinder oils, turbine oils, motor oils, transmission oils, compressor oils, circulation oils, hydraulic oils, insulation oils, carrier oils, process oils, metalworking oils, cooling lubricants, cutting oils and lubricant greases. Preference is given in accordance with the invention to use in lubricant oils, especially in mineral oil-free forming lubricants.

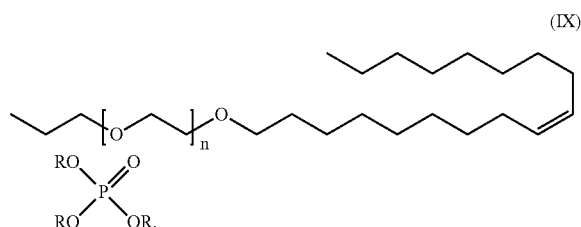
[0090] Preference is likewise given in accordance with the invention to the use of an additive of the invention in lubricants which are used in the food sector, in medical technology, or else for lubrication in the “open sea offshore sector” (open sea wind turbines).

[0091] The lubricants of the invention, especially lubricant oils, generally consist of a base oil and the additives of the invention and possible further additives.

[0092] Base oils used may especially be mineral oils, for example mineral oil distillate fractions; synthetic oils, for example polyethers such as polyglycols and polyphenyl

ethers; carboxylic esters; phosphoric and phosphonic esters; silicones; silicate esters and polyolefins or mixtures thereof.

[0093] Phosphoric esters preferred in accordance with the invention are those which contain, apart from the strongly polar phosphate group, also at least one or better more than one polar group (ethoxy, butoxy groups) and simultaneously have long C—C chains (C8 to C14). Particular preference is given to tributoxylalkyl phosphate having chain lengths of C9 to C12. Preference is likewise given to alkoxy-substituted triphenyl phosphates and trialkylammonium phosphites. The alkyl chain lengths on the nitrogen here are preferably 9 to 14. Also usable in accordance with the invention are dialkyl phosphates having chain lengths of 8 to 12, and likewise alkoxyalkylated dialkyl phosphates. Thiadiazole solutions comprising tributoxylalkyl phosphate can be introduced into almost all media (especially mineral oil-based media) without any great miscibility gaps. Phosphoric esters likewise preferred in accordance with the invention are phosphoric esters with oleyl ethoxylate radicals as shown in formula IX in which R is hydrogen or

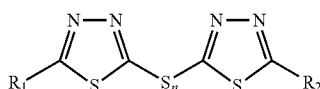


[0094] Further usable additives are, for example, oxidation inhibitors, for example sterically hindered phenols, amines, zinc dithiophosphates; corrosion and rust inhibitors, for example amine phosphates, alkylsuccinic acids, fatty acids; friction modifiers, for example fatty acids, fatty amines; detergents, for example standard or basic Ca, Ba and Mg sulfonates or Ca, Ba and Mg phosphonates; dispersants, for example polymers such as nitrogen-containing polymethacrylates, alkylsuccinimides, succinate esters; pour point depressants, for example alkylated naphthalenes and phenols; viscosity index improvers, for example polyisobutylenes, polyacrylates, hydrogenated styrene-butadiene copolymers; foam inhibitors, for example silicone polymers, tributyl phosphate; adhesion improvers, for example soaps, polyacrylates; emulsifiers, for example sodium salts of organic sulfonic acids, fatty amine salts; bactericides, for example phenols or formaldehyde derivatives.

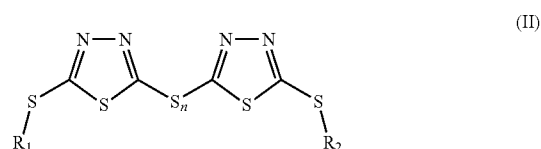
1. A process for producing a lubricant additive, wherein

a)

i) a dimeric thiadiazole compound, especially a bis(2-alkyl-1,3,4-thiadiazolyl) 5,5'-disulfide derivative of the formula (I)



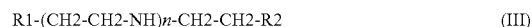
and/or a dimeric 2,5-dimercapto-1,3,4-thiadiazolethiol derivative of the formula (II)



where n in the formulae (I) and (II) is 1 or 2 and

R1 and R2 are each independently hydrogen, linear or branched alkyl groups having 1 to 12 carbon atoms, especially thioalkyl groups having 1 to 12 carbon atoms, aromatic radicals or heteroaromatic radicals.

ii) is dissolved in a polyamine or polyamine derivative of the formula (III)



where n in formula (III) is an integer from 1 to 15,
especially an integer from 3 to 8, and

R1 and R2 are each independently hydrogen, —NH2, linear or branched alkyl groups having 1 to 12 carbon atoms or a modified or unmodified succinimide group, and

iii) a compound of the formula (IV)

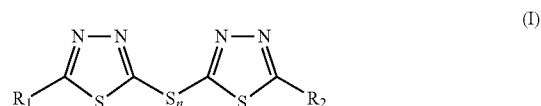


in which n is an integer from 1 to 8, especially an integer from 3 to 8, preferably 6, is added to the solution obtained.

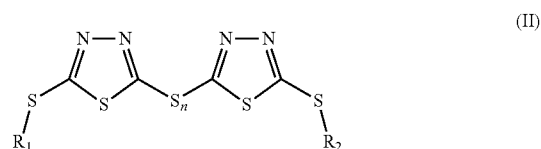
or

b)

i) a dimeric thiadiazole compound, especially a bis(2-alkyl-1,3,4-thiadiazolyl) 5,5'-disulfide derivative of the formula (I)



and/or a dimeric 2,5-dimercapto-1,3,4-thiadiazolethiol derivative of the formula (II)



where n in the formulae (I) and (II) is 1 or 2 and

R1 and R2 are each independently hydrogen, linear or branched alkyl groups having 1 to 12 carbon atoms.

especially thioalkyl groups ($-\text{SR}$) having 1 to 12 carbon atoms, aromatic radicals or heteroaromatic radicals,

- ii) is dissolved in a polyol, especially a polyether polyol having a high propylene oxide content and/or a triglyceride having a hydroxy fatty acid component, and
- iii) a hydrophobic phenol derivative and/or unsaturated fatty alcohol is added to the solution obtained.

2. The process as claimed in claim 1, wherein

in alternative a), the dimeric thiadiazole compound used is 5,5'-dithiobis(1,3,5-thiadiazole-2-thiol), and/or

in alternative a), the polyamine or polyamine derivative of the formula (III) used is the mono-succinimide derivative of the formula (V) or the bissuccinimide derivative of the formula (VI), and/or

in alternative a), the compound of the formula (IV) used is farnesene, lycopene or squalene.

3. The process as claimed in claim 1, wherein

in alternative b), the dimeric thiadiazole compound used is 5,5'-dithiobis(1,3,5-thiadiazole-2-thiol), and/or

in alternative b), the polyol used is a hydrophobic polyether polyol of the formula (VII), and/or

in alternative b), the triglyceride having a hydroxy fatty acid component used is castor oil or ricinoleic acid, and/or

in alternative b), the hydrophobic phenol derivative used is cardol, cardanol or anacardic acid, and/or

in alternative b), the unsaturated fatty alcohol used is hexadecenol or octadecenol.

4. The process as claimed in claim 1, wherein

the compounds of the formulae (I) and (II) in alternative a) are used with a proportion by weight of 4% to 13%, preferably 8% to 10%, and

the compounds of the formula (III) in alternative a) are used with a proportion by weight of 30% to 95%, preferably 40% to 60%, and

the compounds of the formula (IV) in alternative a) are used with a proportion by weight of 10% to 60%, preferably 30% to 50%, or

the compounds of the formulae (I) or (II) in alternative b) are used with a proportion by weight of 3% to 6%, preferably 4% to 5%, and

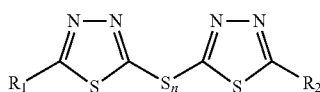
the polyols and/or triglycerides with a hydroxy fatty acid component in alternative b) are used with a proportion by weight of 40% to 96%, preferably 50% to 80%, and

the hydrophobic phenol derivatives and/or unsaturated fatty alcohols in alternative b) are used with a proportion by weight of 40% to 96%, preferably 50% to 80%.

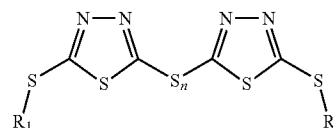
5. The lubricant additive obtainable according to claim 1.

6. A lubricant additive comprising

- I. a dimeric thiadiazole compound, especially a bis(2-alkyl-1,3,4-thiadiazolyl) 5,5'-disulfide derivative of the formula (I)



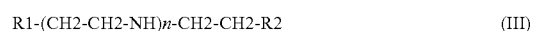
and/or a dimeric 2,5-dimercapto-1,3,4-thiadiazolethiol derivative of the formula (II)



where n in the formulae (I) and (II) is 1 or 2 and

R1 and R2 are each independently hydrogen, linear or branched alkyl groups having 1 to 12 carbon atoms, especially thioalkyl groups having 1 to 12 carbon atoms, aromatic radicals or heteroaromatic radicals,

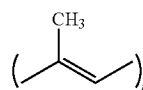
- II. a polyamine or polyamine derivative of the formula (III)



where n in formula (III) is an integer from 1 to 15, especially an integer from 3 to 8, and

R1 and R2 are each independently hydrogen, $-\text{NH}_2$, linear or branched alkyl groups having 1 to 12 carbon atoms or a modified or unmodified succinimide group, and

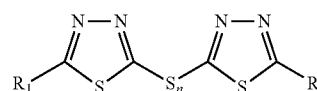
- III. a compound of the formula (IV)



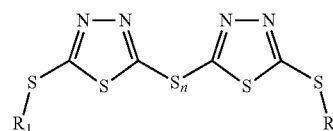
in which n is an integer from 1 to 8, especially an integer from 3 to 8, preferably 6.

- 7. A lubricant additive comprising

- I. a dimeric thiadiazole compound, especially a bis(2-alkyl-1,3,4-thiadiazolyl) 5,5'-disulfide derivative of the formula (I)



and/or a dimeric 2,5-dimercapto-1,3,4-thiadiazolethiol derivative of the formula (II)



where n in the formulae (I) and (II) is 1 or 2 and

R1 and R2 are each independently hydrogen, linear or branched alkyl groups having 1 to 12 carbon atoms, especially thioalkyl groups having 1 to 12 carbon atoms, aromatic radicals or heteroaromatic radicals,

- II. a polyol, especially a polyether polyol having a high propylene oxide content, i.e. having a low ethyl oxide/propylene oxide ratio, and/or a triglyceride having a hydroxy fatty acid component, and

III. a hydrophobic phenol derivative and/or unsaturated fatty alcohol.

8. The lubricant, especially lubricant oil, comprising a lubricant additive as claimed in claim **5**, preferably in a concentration of 0.2% by weight to 10% by weight.

9. The use of a lubricant additive wherein in claim **5** in lubricants and especially lubricant oils, more preferably in mineral oil-free forming lubricants.

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