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(54) **AQUEOUS COMPOSITION FOR LUBRICATING AND/OR COOLING A PROPULSION SYSTEM OF AN ELECTRIC OR HYBRID VEHICLE**

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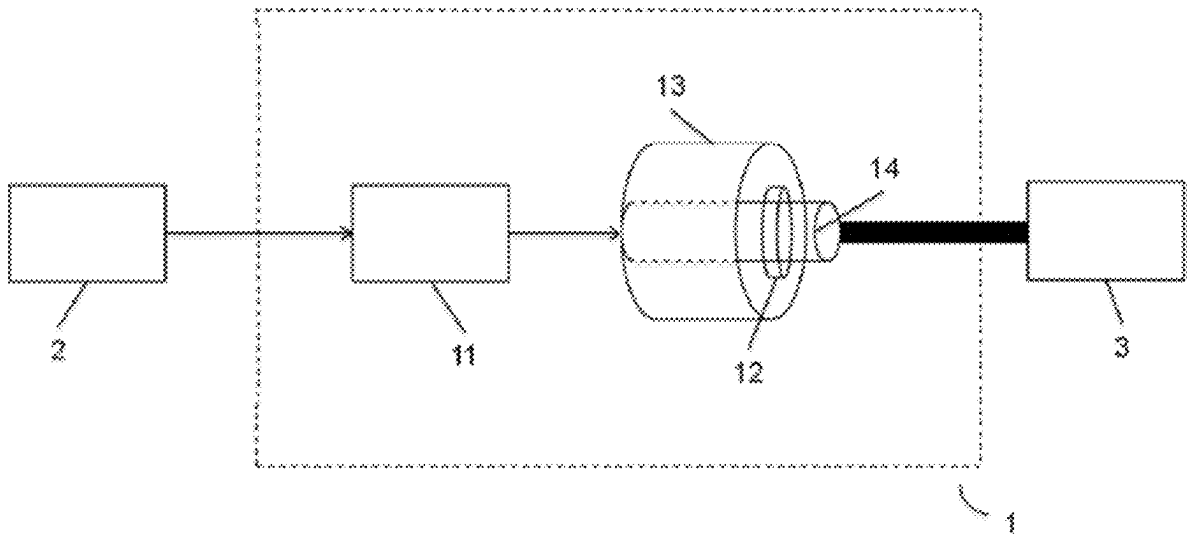
(57) **ABSTRACT**

The present application concerns the use, for cooling and/or lubricating a propulsion system of an electric or hybrid vehicle, of an aqueous lubricating composition comprising at least: water and a polyalkylene glycol; the said aqueous lubricating composition comprising a phosphate ester salt(s) content of strictly less than 0.1% by mass, relative to the total mass of the said composition.

It also relates to the use of such an aqueous lubricant composition to reduce pitting by mechanical fatigue of the mechanical part(s) of an electric or hybrid vehicle propulsion system which is (are) brought into contact with the said composition.

Lastly, it relates to an aqueous lubricating composition for lubricating and/or cooling an electric or hybrid propulsion system, comprising: at least 45% by mass of water, relative to the total mass of the composition, and a polyalkylene glycol; the said composition comprising a phosphate ester salt(s) content of strictly less than 0.1% by mass, relative to the total mass of the said composition.



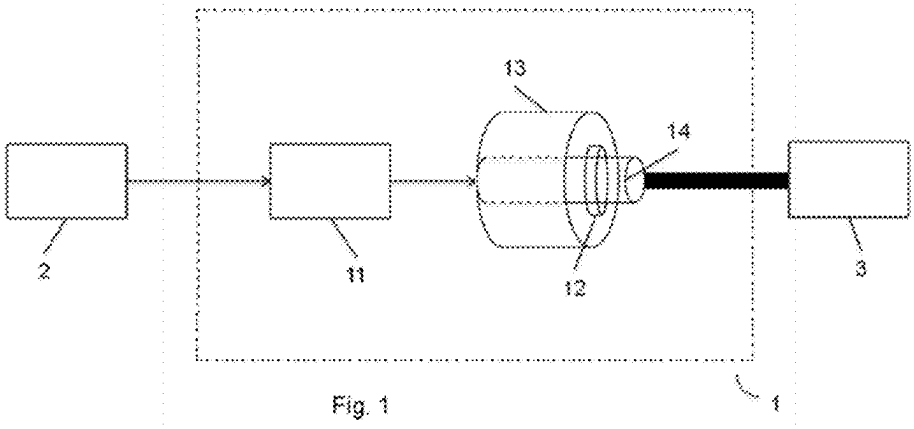


Fig. 1

AQUEOUS COMPOSITION FOR LUBRICATING AND/OR COOLING A PROPULSION SYSTEM OF AN ELECTRIC OR HYBRID VEHICLE

TECHNICAL FIELD

[0001] The present invention relates to the field of lubricant compositions intended for a propulsion system of an electric or hybrid vehicle. More particularly, it aims to propose an aqueous-based lubricant composition, which has both lubricating and cooling properties with respect to the various components of a propulsion system of an electric or hybrid vehicle, such as the transmission, the engine and the battery.

PRIOR ART

[0002] The evolution of international standards for the reduction of CO_2 emissions, but also for the reduction of energy consumption, is pushing automobile manufacturers to propose alternative solutions to combustion engines.

[0003] One of the solutions identified by automobile manufacturers consists in replacing combustion engines with electric motors. The research aimed at reducing CO_2 emissions has thus led to the development of electric or hybrid vehicles by a certain number of automobile companies.

[0004] For the purposes of the present invention, an "electric vehicle" is understood to denote a vehicle comprising an electric motor as sole means of propulsion, and a "hybrid vehicle" is intended to denote a vehicle which comprises a combustion engine and an electric motor as combined means of propulsion.

[0005] For the purposes of the present invention, a "propulsion system" is understood to denote a system comprising the mechanical parts required for propelling an electric vehicle. The propulsion system thus more particularly encompasses an electric motor, the rotor-stator assembly of the power electronics (dedicated to controlling the speed), a transmission and a battery.

[0006] In general, it is necessary to use, in electric or hybrid vehicles, compositions to meet the double constraint of lubricating and cooling the various parts of the propulsion system recalled above.

[0007] On the one hand, lubricant compositions, also known as "lubricants", are commonly used in engines for the purpose of reducing the friction forces between the various metal parts moving in engines, and thus protecting the parts against wear. In addition to wear phenomena, friction can oppose the relative movement of parts that are in contact and induce energy losses that are detrimental to the optimum operating of the propulsion system.

[0008] To do this, a lubricant composition is conventionally composed of one or more base oils which are generally combined with several additives intended for stimulating the lubricant performance of the base oils, for instance friction-modifying additives.

[0009] Moreover, electric propulsion systems generate heat during their functioning via the electric motor, the power electronics and the batteries. Since the amount of heat generated is greater than the amount of heat normally dissipated to the environment, it is necessary to ensure cooling of the motor, the power electronics and the batteries. In general, the cooling takes place on several parts of the propulsion system which generate heat and/or the heat-sensitive parts of said system, so as to prevent dangerous temperatures from being reached, and notably the power electronics and the batteries. This cooling is typically provided by a coolant, different from the hydrocarbon-based lubricant, such as for example air, an aqueous fluid, such as water or else by a mixture of water and a glycol.

[0010] For obvious reasons of cost and ease of implementation, it would be advantageous to be able to have a composition that simultaneously meets the lubrication and cooling requirements of a propulsion system of an electric or hybrid vehicle.

[0011] The most common lubricants are hydrocarbon-based lubricants. However, these hydrocarbon-based oils generally do not result in sufficient heat dissipation that would allow them to be used jointly as cooling fluids.

[0012] More recently, and in response to a growing expectation to dispense with the use of toxic solvents and to reduce the impact of products on the environment, studies have related to the development of aqueous-based lubricants.

[0013] Although water is an excellent coolant, it does not however have the tribological properties required for a lubricant, in particular in terms of reducing friction and protecting parts against wear. Additivation systems which make it possible to confer satisfactory lubrication performance on the aqueous fluid have thus been proposed.

[0014] For example, application WO 2021/259853 describes an aqueous lubricant composition comprising a polyalkylene glycol, an antifreeze compound and a phosphorus compound.

[0015] However, this aqueous lubricant is not entirely satisfactory, in particular in view of the phenomenon of mechanical fatigue pitting that it is liable to generate. In fact, it has been found that this lubricant composition can generate this type of failure in the mechanical contacts, in particular depending on the formulation protocol of the composition.

STATEMENT OF THE INVENTION

[0016] The present invention aims precisely to provide a novel aqueous-based composition, having tribological and cooling properties, suitable for its use for lubricating and/or cooling a propulsion system of an electric or hybrid vehicle, while reducing, or even dispensing with, the phenomena of mechanical fatigue pitting.

[0017] More particularly, the present invention relates, according to a first of its aspects, to the use, for cooling and/or lubricating a propulsion system of an electric or hybrid vehicle, in particular of an electric vehicle, of an aqueous lubricant composition comprising at least:

[0018] water, preferably deionized water; and

[0019] one polyalkylene glycol;

said aqueous lubricant composition comprising a content of salt(s) of phosphate ester(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, relative to the total weight of said composition.

[0020] Preferably, an aqueous lubricant composition according to the invention comprises less than 0.05% by weight, in particular less than 0.01% by weight, of phosphate ester salt(s), in particular chosen from alkali metal salts of phosphate esters, or is even completely free of phosphate ester salts.

[0021] Advantageously, the aqueous lubricant composition according to the invention comprises less than 0.1% by weight of sulfur-containing fatty acid(s), preferably less than 0.01% by weight, in particular is completely free of sulfur-containing fatty acid.

[0022] For the purposes of the present invention, the term "aqueous composition" is intended to denote a composition comprising water as the base fluid, in other words as the majority solvent. The water, preferably deionized, advantageously represents more than 35% by weight, in particular more than 40% by weight, and in particular more than 50% by weight, of the total weight of the lubricant composition.

[0023] In the remainder of the text, the term "aqueous lubricant composition" or "aqueous lubricant" will denote a lubricant composition required according to the invention as defined above and detailed in the remainder of the text. By virtue of its cooling properties, such a composition may also be referred to as an "aqueous composition for cooling" or alternatively as an "aqueous cooling composition".

[0024] Advantageously, a lubricant composition used according to the invention, formed mainly from water, has little toxicological impact, in particular for the people using this lubricant.

[0025] Moreover, even when water is the majority solvent, a composition according to the invention has good properties in terms of lubrication.

[0026] Thus, an aqueous lubricant composition according to the invention advantageously combines good cooling properties linked to the presence of water, and good tribological properties, in particular friction reduction and wear resistance properties. Thus, an aqueous composition according to the invention can perform the dual function of the lubricating and cooling of the motorization system of the electric or hybrid vehicle, in particular of the electric motor, of the power electronics, of the transmission and/or of the battery of an electric or hybrid vehicle.

[0027] The invention thus relates, according to another of its aspects, to a process for lubricating and/or cooling a propulsion system of an electric or hybrid vehicle, comprising at least one step of bringing at least one mechanical part of said propulsion system into contact with an aqueous lubricant composition as defined above.

[0028] Thus, an aqueous composition according to the invention advantageously makes it possible to dispense with the use of two distinct fluids, on the one hand a cooling fluid and on the other hand a lubricating fluid.

[0029] In particular, an aqueous lubricant composition according to the invention makes it possible to ensure efficient cooling of the engine, of the power electronics and of the battery, and also the lubrication of the electric motor, of the transmission, in particular of the reduction gear, in an electric or hybrid vehicle.

[0030] In particular, an aqueous lubricant composition according to the invention can be used to lubricate and/or cool the reduction gear and/or the motor and/or the power electronics of an electric vehicle.

[0031] Likewise, as illustrated in the examples which follow, the inventors have discovered that an aqueous lubricant according to the invention as described above, in particular wherein the content of salt(s) of phosphate esters, if present, remains strictly less than 0.1% by weight, makes it possible to reduce, or even to dispense with, the phenomena known as mechanical fatigue pitting.

[0032] An aqueous lubricant composition according to the invention thus proves to be suitable for use in lubricating and/or cooling propulsion systems of electric or hybrid vehicles, but also for reducing mechanical fatigue pitting, in these systems.

[0033] The present application thus relates to the use of an aqueous lubricant composition intended to lubricate and/or cool a propulsion system of an electric or hybrid vehicle, comprising at least:

[0034] water, preferably deionized water; and

[0035] one polyalkylene glycol;

said aqueous lubricant composition comprising a content of salt(s) of phosphate ester(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, relative to the total weight of the composition, for reducing mechanical fatigue pitting, of the mechanical part (s) of said propulsion system in contact with said composition.

[0036] The invention also relates, according to another of its aspects, to an aqueous lubricant composition for lubricating and/or cooling an electric or hybrid propulsion system, comprising at least:

[0037] 45% by weight of water, in particular at least 50% by weight of water, preferably of deionized water, relative to the total weight of the composition; and

[0038] one polyalkylene glycol;

said aqueous lubricant composition comprising a content of salt(s) of phosphate ester(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, relative to the total weight of the composition.

[0039] Moreover, an aqueous lubricant composition according to the invention advantageously makes it possible to act efficiently on fuel consumption via its impact on the frictional forces generated between the various components of hybrid vehicles. In particular, an aqueous lubricant composition proves to be very particularly advantageous for reducing friction in gearboxes, in axle differentials and/or in the cylinder head. By thus reducing the friction between the moving parts in the propulsion system of the vehicle, a lubricant composition according to the invention makes it possible not only to reduce wear, but also to limit the energy losses responsible for excessive fuel consumption.

[0040] An aqueous lubricant composition according to the invention thus advantageously has good properties in terms of reducing the fuel consumption of hybrid vehicles, also known as "Fuel Eco" properties.

[0041] The invention thus relates, according to another of its aspects, to the use of an aqueous lubricant composition according to the invention for reducing the fuel consumption of a combustion engine of a hybrid vehicle lubricated by means of this composition, or of a hybrid vehicle equipped with a transmission, in particular an axle assembly or a gearbox, said transmission being lubricated by means of this composition.

[0042] Other characteristics, variants and advantages of an aqueous lubricant composition according to the invention and of the use thereof for lubricating and/or cooling a propulsion system of an electric or hybrid vehicle will become clearer on reading the description and examples which follow, given by way of illustration and without limitation of the invention. The expressions "between . . . and . . . ", "ranging from . . . to . . . ", "formed from . . . to

. . . ", and "varying from . . . to . . . " should be understood as being meaning inclusive of limits, unless otherwise stated.

[0043] In the description and the examples, unless otherwise indicated, the percentages are weight percentages. Percentages are thus expressed as weights relative to the total weight of the composition. The temperature is expressed in degrees Celsius unless otherwise indicated, and the pressure is atmospheric pressure, unless otherwise indicated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0044] FIG. **1** schematically represents a propulsion system of an electric or hybrid vehicle.

DETAILED DESCRIPTION

Aqueous Composition

[0045] As mentioned previously, an aqueous lubricant composition used according to the invention, also called an aqueous lubricant, is a formulation comprising water as the majority solvent.

[0046] For the purposes of the invention, the term "majority solvent" means that water is present in a greater amount than any other solvent that may be present in the composition. Preferably, an aqueous lubricant composition according to the invention comprises at least 20% by weight of water, in particular deionized water, preferably at least 30% by weight, in particular between 35% and 90% by weight, more preferentially between 40% and 75% by weight, in particular between 40% and 60% by weight, relative to the total weight of the composition.

[0047] According to one embodiment, an aqueous lubricant composition according to the invention comprises at least 45% by weight, in particular at least 50% by weight of water, in particular of deionized water, preferably between 50% and 90% by weight, more preferentially between 50% and 75% by weight of water, in particular between 50% and 60% by weight of water, relative to the total weight of the composition.

[0048] Advantageously, in addition to its role as a solvent, water provides access to a lubricant composition having good cooling properties, and which can be used as cooling fluid for the various components in a propulsion system of an electric or hybrid vehicle.

[0049] For the purposes of the present invention, the term "cooling fluid" is understood to denote a fluid capable of dissipating the heat generated by a propulsion system of an electric or hybrid vehicle. More specifically, such a fluid is characterized by an increased heat absorption capacity when it comes into contact with a part that is being heated.

[0050] According to a particular embodiment, the water used in an aqueous lubricant composition required according to the invention is demineralized or osmosed water, in particular deionized water.

[0051] For the purposes of the present invention, the term "osmosed water" is intended to denote water which has undergone a purification, notably via a reverse osmosis process, so as to reduce the content of organic and/or mineral compounds, for example to a content of less than 5.0% by weight, preferably less than 1.0% by weight. In the continuation of the text, the terms "demineralized water" or "ultrapure water" will be considered to be equivalent to or synonymous with the term "osmosed water". In particular, osmosed water may be "deionized water", in other words water which has undergone a purification so as to reduce the content of ions such as the Ca^{2+} and HCO_3^- ions generally present in water. Preferably, a deionized water does not comprise any ions.

[0052] The use of deionized water is therefore particularly advantageous in the context of the use of the aqueous lubricant according to the invention for the components of the propulsion system of electric or hybrid vehicles requiring a fluid that conducts electricity little or not at all, for instance the electric motor or the battery.

[0053] An aqueous lubricant composition used according to the invention differs from lubricants conventionally used in vehicle propulsion systems, which comprise a majority proportion of one or more water-insoluble base oils.

[0054] The term "water-insoluble oil" is understood to mean in particular an oil which does not dissolve substantially in water at ambient temperature (at about 25° C.). In particular, a water-insoluble oil has a solubility in water of less than 0.2 g/L at ambient temperature.

[0055] This notably concerns lubricant base oils belonging to groups I to V according to the classes defined in the API classification (or their equivalents according to the ATIEL classification) and mixtures thereof.

[0056] Preferably, an aqueous lubricant composition used according to the present invention comprises less than 5% by weight of water-insoluble base oil(s), preferably less than 2% by weight, more preferentially less than 1% by weight, relative to the total weight of the composition.

[0057] Advantageously, an aqueous lubricant composition used according to the invention is totally free of water-insoluble oil.

Polyalkylene Glycol

[0058] As indicated above, an aqueous lubricant composition used according to the invention comprises at least one polyalkylene glycol.

[0059] The polyalkylene glycols (denoted "PAGs") are chosen from water-soluble polyalkylene glycols.

[0060] The term "water-soluble" denotes a polyalkylene glycol having a solubility in water of at least 10 g/l, preferably at least 500 g/l, in water at ambient temperature (about 25° C.).

[0061] The polyalkylene glycols may be more particularly formed of C_1-C_4, preferably C_1-C_3, more particularly C_2-C_3, alkylene oxide units.

[0062] Advantageously, a polyalkylene glycol used in an aqueous lubricant composition required according to the invention comprises at least 50% by weight, in particular at least 80% by weight, more preferentially at least 90% by weight of propylene oxide and/or ethylene oxide units. It may be a copolymer, optionally a random copolymer, of ethylene oxide/propylene oxide.

[0063] Preferably, a polyalkylene glycol used in an aqueous lubricant composition according to the invention has a weight-average molecular weight (Mw) of between 100 and 50 000 $g \cdot mol^{-1}$, preferably between 5000 and 25 000 $g \cdot mol^{-1}$.

[0064] The weight-average molecular weight can be measured by gel permeation chromatography (GPC).

[0065] Preferably, a polyalkylene glycol used in an aqueous lubricant composition according to the invention has a kinematic viscosity measured at 100° C. (KV100), accord-

ing to the ASTM D445 standard, of between 100 and 25 000 mm^2/s, in particular between 150 and 10 000 mm^2/s.

[0066] Preferably, a polyalkylene glycol used in an aqueous lubricant composition according to the invention has a kinematic viscosity measured at 40° C. (KV40), according to the ASTM D445 standard, of between 500 and 100 000 mm^2/s, more particularly between 1000 and 95 000 mm^2/s.

[0067] The flash point of a polyalkylene glycol used in an aqueous lubricant composition according to the invention is preferably above or equal to 160° C., in particular above or equal to 220° C.

[0068] The flash point can be measured by the ISO 2592 or ASTM D92 standard.

[0069] Preferably, a polyalkylene glycol used in an aqueous lubricant composition according to the invention has a viscosity index, measured according to the standard ASTM D2270, of between 100 and 800, preferably between 250 and 550.

[0070] In particular, said polyalkylene glycol compound (s) can be used in an aqueous lubricant composition required according to the invention in a content of at least 5.0% by weight, preferably between 5.0% and 50% by weight, more preferentially between 10% and 40% by weight, in particular between 10% and 20% by weight, relative to the total weight of the composition.

[0071] Preferably, an aqueous lubricant composition used according to the invention comprises less than 17% of polyalkylene glycol compound(s), more preferentially between 10% and 15% by weight of polyalkylene glycol compound(s).

[0072] It is understood that an aqueous lubricant composition used according to the invention may comprise a single polyalkylene glycol or a mixture of several different polyalkylene glycols.

[0073] In particular, an aqueous lubricant composition according to the invention may comprise a mixture of at least two distinct polyalkylene glycols, more particularly of at least one polyalkylene glycol of low weight-average molecular weight and of at least one polyalkylene glycol of high weight-average molecular weight.

[0074] It falls within the general competence of a person skilled in the art to adjust the nature and the content of polyalkylene glycols of low and high weight-average molecular weight of the mixture of polyalkylene glycols, in particular with regard to the viscosity targeted for the final lubricant composition.

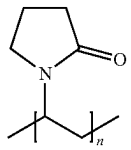
[0075] The combination of at least one polyalkylene glycol of low weight-average molecular weight and at least one polyalkylene glycol of high weight-average molecular weight is most particularly advantageous in order to obtain good solubilization of the various compounds introduced into the aqueous lubricant composition.

[0076] According to an implementation variant, it is possible to use, alternatively to the polyalkylene glycol(s) or together with the latter, one or more vinylpyrrolidone polymer(s).

[0077] The term "polymer" is understood to denote, in the broad sense, both vinylpyrrolidone homopolymers and copolymers formed from vinylpyrrolidone and one or more other monomers.

[0078] Thus, more generally, an aqueous lubricant composition used according to the invention may comprise one or more vinylpyrrolidone polymer(s), in particular chosen from polyvinylpyrrolidones (denoted PVPs).

[0079] The polyvinylpyrrolidones correspond more particularly to the following formula:



wherein n is the average number of constituent units of the polymer.

[0080] Such compounds may be synthesized according to any method known to a person skilled in the art, in particular by polymerization of N-vinylpyrrolidone, and may also be commercially available.

[0081] Polyvinylpyrrolidones which are more particularly suitable for the invention have a weight-average molecular weight (Mw) of between 20 000 and 50 000 $g \cdot mol^{-1}$, preferably between 25 000 and 45 000 $g \cdot mol^{-1}$.

[0082] In particular, said vinylpyrrolidone polymer(s), in particular chosen from polyvinylpyrrolidones, may be present in an aqueous lubricant composition according to the invention in a content of at least 5.0% by weight, preferably between 5.0% and 50% by weight, more preferentially between 10% and 40% by weight, in particular between 10% and 20% by weight, relative to the total weight of the composition.

Additives

Phosphorus Compounds

[0083] As indicated above, the content of phosphorus compound(s) of phosphate ester salt type, if present, in an aqueous lubricant composition used according to the invention is strictly less than 0.1% by weight, relative to the total weight of the composition.

[0084] In general, for the purposes of the present invention, a "phosphorus compound" is intended to denote a compound comprising at least one phosphorus atom. Preferably, such phosphorus compounds do not provide sulfur.

[0085] Said phosphorus compound(s) may be used in aqueous compositions in a form soluble or emulsifiable in water, in particular in the form of ionic salts.

[0086] As examples of phosphate ester salts, mention may be made of salts of alkyl, alkenyl or aryl phosphate esters, in particular of C_1-C_8alkyl or dialkyl phosphate esters. These salts are in particular in the form of phosphate ions neutralized by an appropriate counterion.

[0087] The salts may be alkali or alkaline-earth metal salts, ammonium salts, alkanolamine salts, in particular C_2-C_8 alkanolamine salts, or alkaneamine salts, in particular C_2-C_8 alkaneamine salts, of phosphate esters.

[0088] Advantageously, the phosphate ester salt(s) are alkali metal salts of phosphate esters.

[0089] When the aqueous lubricant composition according to the invention comprises one or more phosphate ester salts, for example as described above, these salts are used in a content strictly less than 0.1% by weight relative to the total weight of said composition.

[0090] Advantageously, an aqueous lubricant composition used according to the invention comprises less than 0.05% by weight of phosphate ester salt(s), in other words com-

prises a content of phosphate ester salt(s) ranging from 0.0% to 0.05% by weight, in particular less than 0.01% by weight and more particularly less than 0.001% by weight, relative to the total weight of the composition.

[0091] According to a particularly preferred embodiment, an aqueous lubricant composition used according to the invention is completely free of phosphate ester salts.

[0092] An aqueous lubricant composition used according to the invention may comprise one or more other phosphorus compounds distinct from the salts of phosphate esters, referred to as "auxiliary phosphorus compound(s)".

[0093] Mention may be made, by way of examples of auxiliary phosphorus compounds, of amine phosphates; polyphosphates; phosphonates such as phosphonate esters, in particular alkyl, alkenyl or aryl phosphonates; polyphosphonates; carbamyl phosphates; phosphinates; and mixtures thereof.

[0094] They may be in the form of salts, in particular phosphonate or phosphinate ions neutralized by an appropriate counterion.

[0095] The salts may be alkali or alkaline-earth metal salts, ammonium salts, alkanolamine salts, in particular C_2-C_8 alkanolamine salts, alkaneamine salts, in particular C_2-C_8 alkaneamine salts, phosphonate salts or phosphinate salts.

[0096] When the aqueous lubricant composition according to the invention comprises one or more auxiliary phosphorus compound(s), for example as described above, said compounds may be used in a content ranging from 0.01% to 5.0% by weight, in particular ranging from 0.1% to 3.0% by weight, relative to the total weight of the composition.

[0097] According to one embodiment, when the aqueous lubricant composition according to the invention comprises one or more auxiliary phosphorus compound(s), in particular as described above, said compounds are used in a content strictly less than 0.1% by weight, relative to the total weight of said composition.

[0098] Advantageously, the overall content of phosphorus compound(s), including phosphate ester salts or any other auxiliary phosphorus compound, may be strictly less than 0.1% by weight, relative to the total weight of said composition, in particular less than 0.05% by weight.

[0099] In other words, an aqueous lubricant composition used according to the invention preferably comprises a phosphorus compound(s) content strictly less than 0.1% by weight, in particular ranging from 0.0% to 0.05% by weight, in particular less than 0.01% by weight and more particularly less than 0.001% by weight, relative to the total weight of the composition.

[0100] Thus, according to one embodiment, an aqueous lubricant composition used according to the invention comprises at least:

[0101] water, preferably deionized water;

[0102] one polyalkylene glycol; and

said aqueous lubricant composition comprising a phosphorus compound(s) content strictly less than 0.1% by weight, in particular ranging from 0.0% to 0.05% by weight, in particular less than 0.01% by weight and more particularly less than 0.001% by weight, relative to the total weight of the composition.

[0103] According to a particularly preferred embodiment, an aqueous lubricant composition used according to the invention is completely free of phosphorus compound.

[0104] According to a particular embodiment, an aqueous lubricant composition required according to the invention may comprise a phosphorus content of less than or equal to 0.05% by weight, in particular less than or equal to 0.02% by weight and more particularly less than or equal to 0.01% by weight. The phosphorus content can be measured by ICP (Inductively Coupled Plasma). Advantageously, an aqueous lubricant composition required according to the invention is completely free of phosphorus.

Antifreeze Compound

[0105] An aqueous lubricant composition used according to the invention may comprise at least one antifreeze compound chosen from glycols, preferably alkylene glycols; glycerol; diglycerol; triglycerol, and mixtures thereof.

[0106] Thus, according to a preferred embodiment, an aqueous lubricant composition used according to the invention comprises at least:

[0107] water, preferably deionized water;

[0108] one polyalkylene glycol; and

[0109] one antifreeze compound chosen from glycols, preferably alkylene glycols; glycerol;

[0110] diglycerol; triglycerol, and mixtures thereof;

said aqueous lubricant composition comprising a content of phosphate ester salt(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, relative to the total weight of the composition, preferably being free of phosphate ester salts.

[0111] These compounds are known for their antifreeze action, in other words for reducing the freezing temperature of the composition.

[0112] Glycols are diols wherein the two hydroxyl groups are borne by different carbon atoms, preferably by vicinal carbon atoms.

[0113] Preferably, the glycols are alkylene glycols, in particular having from 2 to 10 carbon atoms, in particular from 2 to 6 carbon atoms. As examples, mention may be made of monoethylene glycol, diethylene glycol and propylene glycol.

[0114] The antifreeze compound can also be chosen from glycerol, diglycerol, triglycerol and mixtures thereof.

[0115] Preferably, the antifreeze compound used according to the invention is chosen from monoethylene glycol, diethylene glycol, propylene glycol, glycerol and mixtures thereof.

[0116] Preferably, the antifreeze compound is diethylene glycol.

[0117] In particular, said antifreeze compound(s), in particular as defined above, for example diethylene glycol, may be used in an aqueous lubricant composition according to the invention in a content of at least 1.0% by weight, preferably between 5.0% and 50% by weight, more preferentially between 10% and 45% by weight, in particular between 20% and 40% by weight, relative to the total weight of the composition.

[0118] Preferably, an aqueous lubricant composition used according to the invention comprises a content of antifreeze compound(s), in particular as defined above, for example of diethylene glycol, greater than or equal to 33%, in particular of between 33.5% and 40% by weight, relative to the total weight of said composition.

[0119] According to a particular embodiment, the invention relates to the use, to cool and/or lubricate a propulsion

system of an electric or hybrid vehicle, of an aqueous lubricant composition comprising at least:

[0120] water;

[0121] one polyalkylene glycol; and

[0122] one antifreeze compound chosen from glycols in a content greater than or equal to 33% by weight, relative to the total weight of the composition;

said aqueous lubricant composition comprising a content of salt(s) of phosphate ester(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, relative to the total weight of said composition.

[0123] According to a particular embodiment, the invention relates to an aqueous lubricant composition for lubricating and/or cooling an electric or hybrid propulsion system, comprising at least:

[0124] 45% by weight of water, relative to the total weight of the composition;

[0125] one polyalkylene glycol; and

[0126] one antifreeze compound chosen from glycols in a content greater than or equal to 33% by weight, relative to the total weight of the composition;

said aqueous lubricant composition comprising a content of salt(s) of phosphate ester(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, relative to the total weight of said composition.

[0127] According to a particular embodiment, an aqueous lubricant composition used according to the invention comprises at least:

[0128] 35% by weight of water, in particular of deionized water, preferably 40% to 60% by weight of water; in particular 45% to 60% by weight of water;

[0129] 10% by weight, in particular between 10% and 20% by weight, of at least one polyalkylene glycol, in particular as defined above;

[0130] 5.0% by weight, in particular between 20% and 40% by weight, of at least one antifreeze compound chosen from glycols, preferably alkylene glycols; glycerol; diglycerol; triglycerol, and mixtures thereof, said antifreeze compound preferably being diethylene glycol.

[0131] According to a particular embodiment, the combination consisting of water, said polyalkylene glycol(s) and optionally said antifreeze compound(s) represent more than 90% of the total weight of said aqueous lubricant composition, in particular more than 95%, in particular more than 96%, or even more than 97%, of the total weight of said aqueous lubricant composition.

Other Additives

[0132] An aqueous lubricant composition according to the invention may also comprise various additives.

[0133] It is understood that said additive(s) are compatible with their use in an aqueous medium. Advantageously, the additives are used in a water-soluble or water-emulsifiable form, for example in the form of salts or ionic liquids.

[0134] Needless to say, said additive(s) are chosen with regard to the intended application of the aqueous lubricant.

[0135] Of course, a person skilled in the art will take care to select the optional additives and/or the amount thereof in such a way that the advantageous properties of the aqueous lubricant composition according to the invention, in particular the properties in terms of reduction of mechanical fatigue pitting and in terms of cooling, are not impaired by the proposed addition. Such additives can be more particularly chosen from antifoaming agents, biocides, pH regulators, corrosion inhibitors, antiwear and/or extreme-pressure additives, sequestrants, metal passivating agents, dyes, dispersants, emulsifiers, and mixtures thereof.

[0136] Advantageously, an aqueous lubricant composition according to the invention may comprise one or more additives chosen from antifoaming agents, extreme-pressure agents, corrosion inhibitors, pH regulators, metal passivating agents, dyes, and mixtures thereof.

[0137] An aqueous lubricant composition according to the invention may more particularly comprise from 0.1% to 10% by weight of additives, in particular from 1.0% to 8.0% by weight of additives, relative to the total mass of the composition.

pH Regulator

[0138] An aqueous lubricant composition according to the invention may comprise at least one pH-regulating additive, in particular an alkaline buffer. The pH regulator makes it possible to maintain the desired pH of the lubricant composition, in particular in order to preserve an alkaline pH, advantageously between 8 and 15.

[0139] By maintaining the pH of the aqueous lubricant composition between 8 and 15, said pH regulator(s) make it possible in particular to prevent corrosion of the metal surfaces, but also to promote the solubilization of the various compounds in the lubricant composition, in particular of the polyalkylene glycol(s), in particular as defined above.

[0140] The pH regulator may be chosen from the family of amines, in particular alkanolamines and amino alcohols.

[0141] It may in particular be a pH-regulating additive chosen from alkanolamines, such as dimethylethanolamine (DMEA), ethanolamines, such as monoethanolamine (MEA), diethanolamine (DEA), triethanolamine (TEA), isopropanolamines, such as monoisopropanolamine (MIPA), diisopropanolamine (DIPA) and triisopropanolamine (TIPA); diglycolamine (DGA); ethylene amines, such as ethylene diamine (EDA), diethylene triamine (DETA), triethylene tetramine (TETA), and tetraethylene pentamine (TEPA); cyclamines, such as cyclohexylamine; 2-amino-2-ethyl-1,3-propanediol; 2-amino-2-methyl-1-propanol; and mixtures thereof.

[0142] An aqueous lubricant composition according to the invention may notably comprise from 0.1% to 10% by weight of pH-regulating additive(s), preferably from 0.5% to 5% by weight, relative to the total weight of the composition.

[0143] Advantageously, an aqueous lubricant composition used according to the invention comprises at least one pH-regulating additive making it possible to maintain the pH of said lubricant composition between 8 and 15, in particular between 8.5 and 14, more particularly between 9 and 13, said pH-regulating additive being chosen in particular from alkanolamines, preferably ethanolamines, and more particularly from dimethylethanolamine (DMEA), triethanolamine (TEA), and mixtures thereof.

[0144] Thus, in a particular embodiment, an aqueous lubricant composition required according to the invention comprises at least:

[0145] water, in particular deionized water;

[0146] one polyalkylene glycol, in particular as defined above; and

[0147] one pH-regulating additive which makes it possible to maintain the pH of said lubricant composition between 8 and 15, in particular chosen from alkanolamines,

said aqueous lubricant composition comprising a content of phosphate ester salt(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, relative to the total weight of the composition, preferably being free of phosphate ester salts.

Corrosion Inhibitor

[0148] An aqueous lubricant composition according to the invention may comprise at least one corrosion inhibitor. Corrosion inhibitors advantageously make it possible to reduce or even prevent the corrosion of metal parts. The nature of said corrosion inhibitor(s) can be chosen with regard to the metal to be protected against corrosion, such as aluminum, steel, galvanized steel, or yellow metals, for example copper or brass.

[0149] Among the inorganic corrosion inhibitors that may be mentioned are sodium, potassium, calcium or magnesium nitrites, sulfites, silicates, borates or phosphates, alkali metal, hydroxides, molybdates or phosphates, and zinc, magnesium or nickel sulfates.

[0150] Among the organic corrosion inhibitors that may be mentioned are alkanolamines such as triethanolamine, aliphatic monocarboxylic acids, in particular having from 4 to 15 carbon atoms, for example octanoic acid, aliphatic dicarboxylic acids having from 4 to 15 carbon atoms, for example decanedioic acid, undecanedioic acid, dodecanedioic acid, or mixtures thereof, polycarboxylic acids optionally neutralized with triethanolamine, such as 1,3,5-triazine-2,4,6-tri-(6-aminocaproic acid), alkanoylamidocarboxylic acids, in particular isononanoylamidocaproic acid, and mixtures thereof. Borate-based amides, produced by the reaction of amines or amino alcohols with boric acid, may also be used.

[0151] Preferably, the corrosion inhibitor(s) are distinct from the pH-regulating additive(s), in particular making it possible to maintain the pH of the lubricant composition between 8 and 15, and defined above.

[0152] An aqueous lubricant composition according to the invention may in particular comprise from 0.1% to 5% by weight of corrosion inhibitor(s), in particular as defined above, preferably from 0.5% to 4% by weight, more preferentially from 1% to 2.5% by weight, relative to the total weight of the composition.

[0153] In a particular embodiment, an aqueous lubricant composition required according to the invention comprises at least:

[0154] water, in particular deionized water;

[0155] one polyalkylene glycol, in particular as defined above; and

[0156] one corrosion inhibitor, in particular chosen from organic corrosion inhibitors, more particularly from aliphatic monocarboxylic acids,

said aqueous lubricant composition comprising a content of phosphate ester salt(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, relative to the total weight of the composition, preferably being free of phosphate ester salts.

Antiwear/Extreme-Pressure Additive

[0157] An aqueous lubricant composition according to the invention may comprise at least one antiwear and/or extreme-pressure additive. Their function is to reduce wear and the coefficient of friction, or to prevent metal-to-metal contact by forming a protective film adsorbed onto these surfaces.

[0158] There is a wide variety of antiwear additives, among which mention may be made of those chosen from phosphorus-sulfur additives such as metal alkylthiophosphates or salts thereof. Additives which do not provide phosphorus are preferred, such as, for example, polysulfides, in particular sulfur-containing olefins.

[0159] According to a particular embodiment, an aqueous lubricant composition used according to the invention may comprise at least one extreme-pressure additive chosen from sulfur-containing fatty acids and dimercaptothiadiazoles, preferably used in their neutralized form, in particular neutralized with inorganic alkalinizing agents or alkanolamines, which is emulsifiable or soluble in water.

[0160] Advantageously, an aqueous lubricant composition used according to the invention comprises less than 0.1% by weight of extreme-pressure additive of sulfur-containing fatty acid type, in particular in a neutralized form, preferably less than 0.01% by weight, more particularly less than 0.001% by weight, relative to the total weight of the composition, or is even completely free of extreme-pressure additive of sulfur-containing fatty acid type.

[0161] The sulfur-containing fatty acids may comprise from 8 to 22 carbon atoms, in particular from 12 to 18 carbon atoms.

[0162] The amount of sulfur according to the ASTM D2622 standard provided by said sulfur-containing fatty acid(s) may be between 5% and 30% by weight, in particular between 10% and 20% by weight, relative to the total weight of the composition.

[0163] Preferably, the amount of sulfur active at 150° C. according to the ASTM D 1662 standard provided by said sulfur-containing fatty acid(s) in the aqueous lubricant composition according to the invention is less than or equal to 2% by weight, in particular less than or equal to 1% by weight, more particularly less than 0.1% by weight, relative to the total weight of the lubricant composition.

[0164] For the purposes of the present invention, the term "active sulfur" means sulfur that a chemical compound is capable of yielding or releasing when this compound is placed under the conditions of the ASTM D1662 standard. The ASTM D-1662 standard defines an active sulfur content of a compound at a given temperature as a difference expressed as a weight percentage of sulfur content before and after reaction of a sample of this sulfur-containing compound with a given amount of copper over a fixed time.

[0165] As mentioned above, said sulfur-containing fatty acid(s) are generally used in an aqueous lubricant composition in their form neutralized by an alkalinizing agent, such as sodium hydroxide, potassium hydroxide, or an alkanolamine, such as monoethanolamine, triethanolamine, monoisopropanolamine, diisopropanolamine and triisopropanolamine.

[0166] An aqueous lubricant composition required according to the invention may comprise between 0.01% and 10% by weight of antiwear and/or extreme-pressure additive(s), preferably between 0.2% and 5% by weight, relative to the total weight of the composition.

Antifoaming Agent

[0167] An aqueous lubricant composition according to the invention may comprise at least one antifoaming additive. Antifoaming agents make it possible to prevent foaming of the lubricant fluid.

[0168] This may be, for example, an antifoaming agent based on polysiloxanes or acrylate polymers. Preferably, the antifoaming agent is chosen from three-dimensional siloxanes.

[0169] Also, the antifoaming agents may be polar polymers such as polymethylsiloxanes or polyacrylates.

[0170] In particular, an aqueous lubricant composition according to the invention may comprise from 0.001% to 3.0% by weight of antifoam additive(s), preferably from 0.005% to 1.5% by weight, more preferentially from 0.01% to 1.0% by weight, relative to the total weight of the lubricant composition.

[0171] In a particular embodiment, an aqueous lubricant composition required according to the invention comprises at least:

[0172] water, in particular deionized water;

[0173] one polyalkylene glycol, in particular as defined above; and

[0174] one antifoaming additive, in particular chosen from three-dimensional siloxanes, said aqueous lubricant composition comprising a content of phosphate ester salt(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, relative to the total weight of the composition, preferably being free of phosphate ester salts.

Metal Passivating Agents

[0175] An aqueous lubricant composition according to the invention may comprise at least one metal passivating agent. Metal passivating agents make it possible to protect metal parts by promoting the formation of metal oxide on their surface.

[0176] The metal passivating agents may be chosen, for example, from triazole derivatives, such as tetrahydrobenzotriazole (THBTZ), tolyltriazole (TTZ), benzotriazole (BTZ), amines substituted with a triazole group, such as N,N-bis(2-ethylhexyl)-1,2,4-triazol-1-ylmethanamine, N'-bis(2-ethylhexyl)-4-methyl-1H-benzotriazol-1-methylamine, N,N-bis(heptyl)-ar-methyl-1H-benzotriazole-1-methanamine, N,N-bis(nonyl)-ar-methyl-1H-benzotriazole-1-methanamine, N,N-bis(decyl)-ar-methyl-1H-benzotriazole-1-methanamine, N,N-bis(undecyl)-ar-methyl-1H-benzotriazole-1-methanamine, N,N-bis(dodecyl)-ar-methyl-1H-benzotriazole-1-methanamine, N,N-bis(2-ethylhexyl)-ar-methyl-1H-benzotriazole-1-methanamine, 1,2,4-triazoles, benzimidazoles, 2-alkyldithiobenzimidazoles, 2-alkyldithiobenzothiazoles, 2-(N,N-dialkyldithiocarbamoyl)benzothiazoles, 2,5-bis(alkyldithio)-1,3,4-thiadiazoles, such as 2,5-bis(tert-octyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-nonyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-decyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-undecyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-dodecyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-tridecyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-tetradecyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-pentadecyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-hexadecyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-heptadecyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-octadecyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-nonadecyldithio)-1,3,4-thiadiazole, 2,5-bis(tert-eicosyldithio)-1,3,4-thiadiazole, 2,5-bis(N,N-dialkyldithiocarbamoyl)-1,3,4-thiadiazoles, 2-alkyldithio-5-mercaptothiadiazoles, and mixtures thereof.

[0177] Preferably, the metal passivating agents are chosen from tetrahydrobenzotriazole (THBTZ), tolyltriazole (TTZ), benzotriazole (BTZ), and salts thereof, taken alone or as mixtures.

[0178] An aqueous lubricant composition according to the invention may notably comprise from 0.01% to 2.0% by weight of metal passivating agent(s), preferably from 0.1% to 1.0% by weight, more preferentially from 0.2% to 0.8% by weight, relative to the total weight of the composition.

[0179] In a particular embodiment, an aqueous lubricant composition required according to the invention comprises at least:

[0180] water, in particular deionized water;

[0181] one polyalkylene glycol, in particular as defined above; and

[0182] one metal passivating agent, in particular chosen from triazole derivatives, more particularly chosen from tetrahydrobenzotriazole (THBTZ), tolyltriazole (TTZ), benzotriazole (BTZ), and salts thereof, taken alone or in mixtures,

said aqueous lubricant composition comprising a content of phosphate ester salt(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, relative to the total weight of the composition, preferably being free of phosphate ester salts.

Dyes

[0183] An aqueous lubricant composition according to the invention may comprise one or more dyes. The dyes may be natural or synthetic, generally organic.

[0184] The dyes which can be used in an aqueous lubricant composition may be chosen more particularly from natural or synthetic water-soluble dyes, for example the dyes FDC Red 4, DC Red 6, DC Red 22, DC Red 28, DC Red 30, DC Red 33, DC Orange 4, DC Yellow 5, DC Yellow 6, DC Yellow 8, FDC Green 3, DC Green 5, FDC Blue 1, betanin (beet), xanthenes, carmine, chlorophyllin, methylene blue, anthocyanins (enocyanin, black carrot and hibiscus), caramel and riboflavin.

[0185] An aqueous lubricant composition according to the invention may comprise between 0.01% and 2.0% by weight of dye(s), preferably between 0.01% and 1.5% by weight, more preferentially between 0.02% and 1.0% by weight, relative to the total weight of the composition.

[0186] In a particular embodiment, an aqueous lubricant composition required according to the invention comprises at least:

[0187] water, in particular deionized water;

[0188] one polyalkylene glycol, in particular as defined above; and

[0189] one dye, in particular chosen from xanthenes,

said aqueous lubricant composition comprising a content of phosphate ester salt(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, relative to the total weight of the composition, preferably being free of phosphate ester salts.

Emulsifying Agents

[0190] An aqueous lubricant composition according to the invention may comprise one or more emulsifying agents, also called emulgators. Their function is to generate stable emulsions in water.

[0191] The emulsifying agents may be more particularly nonionic emulsifying agents, such as, for example, ethoxylated fatty alcohols, ethoxylated fatty acids, ethoxylated fatty amides; anionic emulsifying agents, for example KOH soaps or NaOH soaps; sulfonates; cationic emulsifying agents, such as quaternary ammonium compounds; or carboxylic acid esters soluble or emulsifiable in water.

[0192] In particular, an aqueous lubricant composition according to the invention may comprise from 0.01% to 10% by weight of emulsifying agent(s), preferably from 0.1% to 5.0% by weight, relative to the total weight of the lubricant composition.

Sequestrants

[0193] An aqueous lubricant composition according to the invention may comprise at least one sequestrant. Sequestrants, also called chelating agents, make it possible to limit the incrustation of metal ions into the composition.

[0194] As examples of sequestrants, mention may be made of those derived from phosphonic acids and phosphonates, such as diethylenetriamine pentamethyl phosphonic acid (DTPMPA), aminotri(methylene phosphonic) acid (ATMP), hydroxyethane diphosphonic acid (HEDP), 1-hydroxyethylidene 1,1-diphosphonate, 2-hydroxyethylamine di(methylene phosphonic acid) (HEAMBP), diethylene triaminopenta(methylene phosphonic acid) (DTMP), multifunctional organic acids and hydroxy acids, such as ethylenediaminetetraacetic acid (EDTA), pteroyl-L-glutamic acid (PGLU), organic polyacids, such as maleic acid and polyaspartic acid, polysaccharides and carbohydrates, such as inulin, carboxymethyl inulin and carboxymethyl chitosan.

[0195] An aqueous lubricant composition according to the invention may comprise from 0.001% to 2.0% by weight of sequestrant(s), preferably from 0.01% to 1.0% by weight, relative to the total weight of the composition.

Biocides and Fungicides

[0196] An aqueous lubricant composition according to the invention may comprise at least one biocidal and/or fungicidal agent. Biocides and fungicides can be used to improve the biological stability of the composition by limiting the proliferation of bacteria, fungi and yeasts in the lubricant fluid.

[0197] Such biocides may be chosen from parabens, aldehydes, reactive acetylacetone compounds, isothiazolinones, phenolic compounds, acid salts, halogenated compounds, quaternary ammoniums, certain alcohols and mixtures thereof.

[0198] Preferably, the biocides may be chosen from optionally substituted benzisothiazolinones (BIT), such as N-butyl-1,2-benzisothiazolin-3-one, methylisothiazolinones (MIT), mixtures of methylisothiazolinone and chloromethylisothiazolinone (MIT/CMIT), ortho-phenylphenol (OPP) or its sodium salt, 3-iodo-2-propynylbutyl carbamate (IPBC), chlorocresol and N,N-methylenebismorpholine (MBM); sorbic acid; preferably from ortho-phenylphenol (OPP) or its sodium salt, 3-iodo-2-propynylbutyl carbamate, chlorocresol, benzisothiazolinones and N,N-methyleneisomorpholine.

[0199] An aqueous lubricant composition according to the invention may in particular comprise between 0.01% and 10% by weight of biocide(s) and/or fungicide(s), preferably between 0.5% and 5.0% by weight, relative to the total weight of the composition.

[0200] In a particular embodiment, an aqueous lubricant composition required according to the invention comprises at least:

[0201] water, in particular deionized water;

[0202] one polyalkylene glycol, in particular as defined above; and

[0203] one or more additives chosen from antifoaming agents, corrosion inhibitors, pH regulators, metal passivating agents, dyes, in particular as defined above,

said aqueous lubricant composition comprising a content of phosphate ester salt(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, relative to the total weight of the composition, preferably being free of phosphate ester salts.

[0204] In a particular embodiment, an aqueous lubricant composition required according to the invention comprises at least:

[0205] water, in particular deionized water;

[0206] one polyalkylene glycol, in particular as defined previously;

[0207] one antifreeze compound chosen from glycols, preferably alkylene glycols; glycerol;

[0208] diglycerol; triglycerol, and mixtures thereof; and

[0209] one or more additives chosen from antifoaming agents, corrosion inhibitors, pH regulators, metal passivating agents, dyes, in particular as defined above,

said aqueous lubricant composition comprising a content of phosphate ester salt(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, relative to the total weight of the composition, preferably being free of phosphate ester salts.

[0210] According to a particular embodiment, an aqueous lubricant composition used according to the invention comprises:

[0211] at least 35% by weight of water, in particular from 40% to 60% by weight, particularly at least 50% by weight, of water, preferably of deionized water;

[0212] from 5.0% to 50% by weight, in particular from 10% to 20% by weight, of at least one polyalkylene glycol, in particular as defined above;

[0213] optionally from 5.0% to 45%, in particular from 20% to 40% by weight, of at least one antifreeze compound chosen from glycols, preferably alkylene glycols; glycerol; diglycerol;

[0214] triglycerol, and mixtures thereof; preferably diethylene glycol; and

[0215] optionally from 0.1% to 10% by weight of one or more additives chosen from antifoaming agents, extreme-pressure agents, corrosion inhibitors, pH regulators, metal passivating agents, dyes, emulsifiers, sequestrants, and mixtures thereof,

said aqueous lubricant composition comprising a content of phosphate ester salt(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, preferably being free of phosphate ester salts;

[0216] the contents being expressed relative to the total weight of the lubricant composition.

[0217] In particular, an aqueous lubricant composition used according to the invention may consist of:

[0218] from 5.0% to 50% by weight, in particular from 10% to 20% by weight, of at least one polyalkylene glycol, in particular as defined above;

[0219] optionally from 5.0% to 45%, in particular from 20% to 40% by weight, of at least one antifreeze compound chosen from glycols, preferably alkylene glycols; glycerol; diglycerol;

[0220] triglycerol, and mixtures thereof; preferably diethylene glycol; and

[0221] optionally from 0.1% to 10% by weight of one or more additives chosen from antifoaming agents, extreme-pressure agents, corrosion inhibitors, pH regulators, metal passivating agents, dyes, emulsifiers, sequestrants, and mixtures thereof,

said aqueous lubricant composition comprising a content of phosphate ester salt(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, in particular being free of phosphate ester salts;

the contents being expressed relative to the total mass of the lubricant composition,

the balance consisting of water, preferably deionized water.

[0222] It is understood that the various particular embodiments described above may be combined, as far as possible, to define other particular embodiments.

[0223] In particular, each of the additives specifically described above can be introduced alone, or in combination with at least one other of the additives specifically described, thereby defining different implementation variants of an aqueous lubricant composition according to the invention.

[0224] In other words, particular embodiments of the invention are defined by an aqueous lubricant composition according to the invention, comprising at least water; and one or more polyalkylene glycol(s), in particular as defined above, preferably in the proportions indicated above, and also comprising one or more additives detailed specifically in the text.

[0225] According to a particular embodiment, an aqueous lubricant composition used according to the invention comprises:

[0226] from 40% to 55% by weight of water, in particular of deionized water, in particular more than 45% by weight of water;

[0227] from 10% to 15% by weight of one or more polyalkylene glycols;

[0228] optionally from 30% to 40% by weight of an antifreeze compound chosen from glycols, preferably alkylene glycols; glycerol; diglycerol; triglycerol, and mixtures thereof; preferably diethylene glycol;

[0229] optionally from 0.1% to 10% by weight of one or more additives chosen from antifoaming agents, corrosion inhibitors, pH regulators, metal passivating agents, dyes, emulsifiers, sequestrants, and mixtures thereof,

said composition being free of phosphate ester salts, and more preferentially free of phosphorus compounds,

said composition being free of extreme-pressure additives of sulfur-containing fatty acid type.

[0230] According to a particular embodiment, an aqueous lubricant composition used according to the invention comprises hypericin in a content strictly less than 0.1% by weight, preferably less than or equal to 0.01% by weight, more preferentially less than or equal to 0.01% by weight, relative to the total weight of the composition. In particular, an aqueous lubricant composition used according to the invention is completely free of hypericin.

[0231] More generally, an aqueous lubricant composition used according to the invention comprises one or more compound(s) of polycyclic dianthraquinone type in a content strictly less than 0.1% by weight, preferably less than or equal to 0.01% by weight, more preferentially less than or equal to 0.01% by weight, relative to the total weight of the composition. In particular, an aqueous lubricant composition used according to the invention is completely free of polycyclic dianthraquinone type compound.

Application

[0232] As indicated above, an aqueous lubricant composition can be used, by virtue of its combined lubricating and cooling properties, both as a cooling fluid and as a lubricating fluid for a propulsion system of an electric or hybrid vehicle, in particular the engine, power electronics, transmission and/or battery, in an electric or hybrid vehicle, preferably in an electric vehicle.

[0233] As shown diagrammatically in FIG. **1**, the propulsion system of an electric or hybrid vehicle comprises in particular the electric motor part (**1**), an electric battery (**2**) and a transmission, and in particular a speed reducer (**3**). As batteries suitable for the propulsion systems of an electric or hybrid vehicle, mention may be made in particular of Li-ion batteries or nickel-cadmium batteries.

[0234] The electric motor typically comprises power electronics (**11**) connected to a stator (**13**) and a rotor (**14**). The stator comprises coils, in particular copper coils, which are powered by an alternating electric current. This makes it possible to generate a rotating magnetic field. The rotor itself comprises coils, permanent magnets or other magnetic materials, and is rotated by the rotating magnetic field.

[0235] The power electronics (**11**), stator (**13**) and rotor (**14**) of a propulsion system (**1**) are parts of which the structure is complex and generates a large amount of heat during engine operation. It is therefore imperative to ensure cooling of the electric motor, and power electronics.

[0236] A bearing (**12**) is generally integrated between the stator (**13**) and the rotor (**14**). A transmission, and in particular a speed reducer (**3**), makes it possible to reduce the rotational speed at the output of the electric motor and to adapt the speed transmitted to the wheels, making it possible at the same time to control the speed of the vehicle.

[0237] Advantageously, an aqueous lubricant composition according to the invention can be used to cool the battery present in an electric or hybrid vehicle, in particular in an electric vehicle. In particular, it is intended to be brought into direct contact with the battery.

[0238] The cooling can be carried out by any method known to a person skilled in the art. The battery may be in immersion or semi-immersion, static or in circulation, in said composition. As examples of direct contacting, mention may be made of cooling by injection, jet, spraying or else by formation of a mist from the composition required according to the invention under pressure and gravity on the battery.

[0239] A composition according to the invention may also be used to cool the electric motor of an electric or hybrid

vehicle, in particular to cool the power electronics and/or the rotor and/or the stator of the electric motor, preferably in an electric vehicle.

[0240] An aqueous lubricant composition according to the invention can simultaneously be used to lubricate the various parts of a propulsion system of an electric or hybrid vehicle, in particular of the engine, power electrics, transmission and/or battery, more particularly bearings located between the rotor and stator of an electric motor, or the transmission, in particular the reduction gear, in an electric or hybrid vehicle.

[0241] More particularly, an aqueous lubricant composition according to the invention makes it possible to cool and lubricate an electric motor of an electric or hybrid vehicle. It is particularly effective for cooling the power electronics and/or the rotor and/or the stator of an electric motor. It also ensures lubrication of the rolling bearings located between the rotor and the stator of an electric motor of an electric or hybrid vehicle.

[0242] Advantageously, an aqueous lubricant composition according to the invention makes it possible to ensure the lubrication of the transmission, when it is present, in particular the reduction gear, of an electric or hybrid vehicle.

[0243] Thus, advantageously, it is for example possible, by using a single composition according to the invention, to ensure both the cooling of the battery and the lubrication of the transmission, in particular the reduction gear, in an electric or hybrid vehicle.

[0244] Advantageously, the present invention relates to the use of an aqueous lubricant composition as defined according to the invention, for lubricating and/or cooling the reduction gear and/or the motor and/or the power electronics of an electric vehicle.

[0245] The particular, advantageous or preferred characteristics relating to the uses of and processes for using an aqueous lubricant composition according to the invention make it possible to define particular, advantageous or preferred embodiments of an aqueous lubricant composition according to the invention.

Example

[0246] The invention will now be described by means of the examples that follow, which are, needless to say, given as nonlimiting illustrations of the invention.

Measurement of Mechanical Fatigue Pitting

[0247] The mechanical fatigue pitting is evaluated by a test on an MPR (micropitting rig) tribometer.

[0248] The MPR tribometer is a machine which brings a central roller (diameter 12 mm) into contact with three rings (diameter 54 mm) arranged around the roller. This geometric configuration allows the test roller to be subjected to a large number of rolling contact cycles over a short test period, which promotes mechanical fatigue pitting.

[0249] The test is carried out for a period of 20 hours. The fatigue pitting phenomenon is detected using an accelerometer connected to a vibration monitor. When the vibration setpoint is exceeded due to the occurrence of pitting, the test is stopped.

[0250] The performance of the compositions in terms of mechanical fatigue pitting is qualified as insufficient if the pitting time is less than 10 hours, as average if the pitting time is between 10 hours and 20 hours and as good if there is no pitting after 20 hours of testing.

Example 1

Preparation of the Lubricant Compositions

[0251] Two aqueous lubricant compositions (I1 and I2) according to the invention, and a comparative lubricant composition (C1) comprising a phosphorus compound content greater than 0.1% by weight, were formulated by simple mixing, at ambient temperature, of the following components, in the percentages by weight indicated in the following table 1. Percentages are thus expressed as weights relative to the total weight of the composition.

TABLE 1

Composition	Composition I1 according to the invention	Composition I2 according to the invention	Comparative composition C1
Deionized water [%]	42.65	51.94	43.41
Polyalkylene glycol [%]	14.25	11.94	19.49
Diethylene glycol [%]	40	33.52	32.83
Neutralized alcohol phosphate [%]	—	—	1.0
Alkanolamine pH regulator [%]	1.1	0.92	0.9
Neutralized sulfur-containing fatty acid [%]	—	—	0.7
Additives(*) [%]	2	1.68	1.67

(*)Mixture of additives comprising one or more anticorrosion additives, one or more metal passivating agents, one or more antifoam additives and/or one or more dyes.

Example 2

Characterization of the Compositions According to the Invention and Comparative Composition in Terms of Mechanical Fatigue Pitting

[0252] The performances in terms of mechanical fatigue pitting of composition I2, according to the invention, and of comparative composition C1, were evaluated according to the protocol detailed above.

[0253] The results are presented in table 2 below:

TABLE 2

Composition	I2	C1
Pitting performance	Good	Insufficient

[0254] As can be seen from these results, composition I2, in accordance with the invention, exhibits a mechanical fatigue pitting resistance performance which is much better than that obtained for comparative composition C1, characterized in particular by the presence of a phosphorus compound in a content greater than 0.1% by weight, relative to the total weight of the composition.

[0255] Moreover, compositions I1 and I2 according to the invention exhibit excellent performance in terms of cooling in a propulsion system of an electric or hybrid vehicle, in particular cooling of the electric motor.

[0256] Consequently, an aqueous lubricant composition according to the invention can be used for lubricating and/or cooling a propulsion system of an electric or hybrid vehicle,

without having a detrimental effect on mechanical fatigue pitting of the parts lubricated and/or cooled by means of said composition.

1. The use, for cooling and/or lubricating a propulsion system of an electric or hybrid vehicle, of an aqueous lubricant composition comprising at least:

water; and

one polyalkylene glycol;

said aqueous lubricant composition comprising a content of salt(s) of phosphate ester(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, relative to the total weight of said composition.

2. The use as claimed in claim **1**, wherein the aqueous lubricant composition further comprises at least one antifreeze compound chosen from glycols, preferably alkylene glycols, glycerol, diglycerol, triglycerol, and mixtures thereof, more preferentially from monoethylene glycol, diethylene glycol, propylene glycol, glycerol and mixtures thereof.

3. The use as claimed in the preceding claim, wherein the aqueous lubricant composition comprises at least 1.0% by weight of antifreeze compound(s), preferably between 5.0% and 50% by weight, more preferentially between 10% and 45% by weight, in particular between 20% and 40% by weight, relative to the total weight of said composition.

4. The use as claimed in any one of the preceding claims, wherein the water is osmosed water, in particular deionized water.

5. The use as claimed in any one of the preceding claims, wherein the aqueous lubricant composition comprises at least 20% by weight of water, in particular of deionized water, preferably between 35% and 90% by weight, more preferentially between 40% and 75% by weight, in particular between 40% and 60% by weight, relative to the total weight of said composition.

6. The use as claimed in any one of the preceding claims, characterized in that said polyalkylene glycol(s) comprise at least 50% by weight, in particular at least 80% by weight, more preferentially at least 90% by weight of propylene oxide and/or ethylene oxide units, said polyalkylene glycol (s) in particular being an ethylene oxide/propylene oxide copolymer.

7. The use as claimed in any one of the preceding claims, characterized in that said polyalkylene glycol(s) has (have) a kinematic viscosity measured at 100° C. (KV100), according to the standard ASTM D445, of between 100 and 25 000 mm^2/s, in particular between 150 and 10 000 mm^2/s.

8. The use as claimed in any one of the preceding claims, wherein the aqueous lubricant composition comprises at least 5.0% by weight of polyalkylene glycol(s), preferably between 5.0% and 50% by weight, more preferentially between 10% and 40% by weight, in particular between 10% and 20% by weight, relative to the total weight of the composition.

9. The use as claimed in any one of the preceding claims, wherein the aqueous lubricant composition comprises less than 0.05% by weight of phosphate ester salt(s), in particular chosen from alkali metal salts of phosphate esters, preferably less than 0.01% by weight, more particularly less than 0.001% by weight, relative to the total weight of the composition, the aqueous lubricant composition being more preferentially completely free of phosphate ester salts, in particular of alkali metal salts of phosphate esters.

10. The use as claimed in any one of the preceding claims, wherein the aqueous lubricant composition further comprises at least one additive chosen from antifoaming agents, biocides, pH regulators, corrosion inhibitors, antiwear and/or extreme-pressure additives, sequestrants, metal passivating agents, dyes, dispersants, emulsifying agents and mixtures thereof, preferably chosen from antifoaming agents, extreme-pressure agents, corrosion inhibitors, pH regulators, metal passivating agents, dyes, and mixtures thereof.

11. The use as claimed in any one of the preceding claims, wherein the aqueous lubricant composition further comprises at least one pH-regulating additive making it possible to maintain the pH of the lubricant composition between 8 and 15, in particular chosen from alkanolamines.

12. The use as claimed in any one of the preceding claims, wherein the aqueous lubricant composition comprises less than 0.1% by weight of extreme-pressure additive of sulfur-containing fatty acid type, preferably less than 0.01% by weight, more particularly less than 0.001% by weight, relative to the total weight of the composition, more preferentially is completely free of extreme-pressure additive of sulfur-containing fatty acid type.

13. The use of an aqueous lubricant composition as defined in any one of the preceding claims, for lubricating and/or cooling the reduction gear and/or the motor and/or the power electronics of an electric vehicle.

14. The use of an aqueous lubricant composition intended to lubricate and/or cool a propulsion system of an electric or hybrid vehicle, comprising at least:

water; and

one polyalkylene glycol;

said aqueous lubricant composition comprising a content of salt(s) of phosphate ester(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, relative to the total weight of said composition,

for reducing mechanical fatigue pitting, of the mechanical part(s) of said propulsion system in contact with said composition.

15. An aqueous lubricant composition for lubricating and/or cooling an electric or hybrid propulsion system, comprising at least:

45% by weight of water, relative to the total weight of the composition; and

one polyalkylene glycol;

said aqueous lubricant composition comprising a content of salt(s) of phosphate ester(s), in particular chosen from alkali metal salts of phosphate esters, strictly less than 0.1% by weight, relative to the total weight of said composition.

16. The aqueous lubricant composition as claimed in the preceding claim, said composition being as defined in any one of claims **2** to **4** or **6** to **12**.

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