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(54) Titre : FLUIDE LUBRIFIANT MULTIFONCTIONNEL
(54) Title: MULTIFUNCTIONAL LUBRICATING FLUID

(57) Abrégé/Abstract:
The invention pertains to multifunctional lubricating fluids for use in the different assemblies of automotive vehicles, mainly the engine, the transmission or a hydraulic circuit, and relates to a lubricant composition containing at least one oil of the groups I to V and a mixture of at least two polymers having a difference of the permanent shearing stability index (PSSI), as measured by the standardised KRL test for 20 hours at 1000°C, of at least 50, and having a viscosity profile such that: (a) at 1000°C, after a 30 cycle Bosch test following the CEC-L- 14-A-93 standard, the viscosity of the final lubricant composition is higher than 9.0 cSt, preferably in range of 9.0 to 12.0 cSt for a 30 grade starting oil, or the viscosity of the final lubricant composition is higher than 12.0 cSt, preferably in range of 12.0 to 15.0 cSt for a 40 grade starting oil; (b) at 1000°C, after a 20 hour KRL test following the CEC-L-45-A-99 standard, the viscosity of the final lubricant composition is higher than 8.5 cSt, preferably in range of 8.5 to 11.0 cSt for a 30 or 40 grade starting oil; and (c) at 400°C, after a 3 hour KRL test following the CEC-L-45-A-99 standard with a test duration down to 3 hours, the viscosity of the final lubricant composition is lower than 51.0 cSt, preferably in range of 41 to 51 cSt for a 30 or 40 grade starting oil.

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(54) Title: MULTIFUNCTIONAL LUBRICATING FLUID

(54) Titre : FLUIDE LUBRIFIANT MULTIFONCTIONNEL

(57) Abstract: The invention pertains to multifunctional lubricating fluids for use in the different assemblies of automotive vehicles, mainly the engine, the transmission or a hydraulic circuit, and relates to a lubricant composition containing at least one oil of the groups I to V and a mixture of at least two polymers having a difference of the permanent shearing stability index (PSSI), as measured by the standardised KRL test for 20 hours at 1000°C, of at least 50, and having a viscosity profile such that: (a) at 1000°C, after a 30 cycle Bosch test following the CEC-L- 14-A-93 standard, the viscosity of the final lubricant composition is higher than 9.0 cSt, preferably in range of 9.0 to 12.0 cSt for a 30 grade starting oil, or the viscosity of the final lubricant composition is higher than 12.0 cSt, preferably in range of 12.0 to 15.0 cSt for a 40 grade starting oil; (b) at 1000°C, after a 20 hour KRL test following the CEC-L-45-A-99 standard, the viscosity of the final lubricant composition is higher than 8.5 cSt, preferably in range of 8.5 to 11.0 cSt for a 30 or 40 grade starting oil; and (c) at 400°C, after a 3 hour KRL test following the CEC-L-45-A-99 standard with a test duration down to 3 hours, the viscosity of the final lubricant composition is lower than 51.0 cSt, preferably in range of 41 to 51 cSt for a 30 or 40 grade starting oil.

(57) Abrégé : La présente invention concerne les fluides lubrifiants multifonctionnels utilisables dans les différents organes des véhicules automoteurs, notamment dans le moteur, la transmission ou le circuit hydraulique et se rapporte à une composition lubrifiante comprenant au moins une huile des groupes I à V et un mélange d'au moins deux polymères ayant une différence d'indice permanent de stabilité en cisaillement (PSSI), mesuré après test normalisé KRL 20 heures à 1000C d'au moins 25, et ayant un profil de viscosité tel que (a) à 1000C après test Bosch-30 cycles suivant la norme CEC-L- 14-A-93 la viscosité de la composition lubrifiante finale est supérieure à 9,0 cSt, de préférence dans la gamme allant de 9,0 à 12,0 cSt pour une huile au départ de grade 30, ou bien la viscosité de la composition lubrifiante finale est supérieure à 12,0 cSt, de préférence dans la gamme allant de 12,0 à 15,0 cSt pour une huile au départ de grade 40, et (b) à 1000C après test KRL -20 heures suivant la norme CEC-L-45-A-99 la viscosité de la composition lubrifiante est supérieure à 8,5 cSt, de préférence dans la gamme allant de 8,5 à 11,OcSt pour une huile au départ de grade 30 ou 40, et (c) à 400C après test KRL-3 heures, suivant la norme CEC-L-45-A-99 dont la durée d'essai est réduite à 3 heures, la viscosité de la composition lubrifiante est inférieure à 51 cSt, de préférence dans la gamme allant de 41 à 5IcSt pour une huile au départ de grade 30 ou 40.

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MULTIFUNCTIONAL LUBRICATING FLUID

Field of the invention

The present invention relates to multifunctional lubricating fluids for use in the various mechanisms of motor vehicles, in particular in the engine, the transmission or the hydraulic circuit. More precisely, the invention relates to a single fluid that can be used directly in several types of applications, in particular in the various mechanisms of motor vehicles such as engines, transmission devices (gearboxes and transfer boxes), hydraulic circuits and other ancillary mechanisms without any need for modification; in other words, the composition of this fluid is directly suitable for the various types of use in question.

Background of the invention

At present every motor vehicle uses a variety of monofunctional lubricating fluids, each fulfilling different functions, for example engine oils, gearbox oils, hydraulic oils etc.

The formulation of a monofunctional oil consists conventionally of a mixture of mineral, semi-synthetic or synthetic base oils, a package of performance additives, and optionally a viscosity improving polymer and a pour point improver.

When a monofunctional lubricating oil is in service in a mechanism, the constant shear to which the viscosity improving polymer is subjected leads to a decrease in viscosity of the oil. The extent and rate of this decrease in viscosity depend on the nature and amount of viscosity improving polymer used.

Now, the shear rates to which the lubricant is subjected differ from one mechanism to another. For example, the high-pressure hydraulic circuits operating the lifting mechanisms produce more shear than the gearboxes, and they in turn produce more shear than the engines.

If a monofunctional oil is used in a mechanism other than that for which it has been formulated, its viscosity may move away from the value required for optimum functioning of said mechanism.

Formulations of multifunctional oils for engine, gearbox and hydraulic circuit are already marketed under the names TOTAL Multi TP, FINA Penta, ELF Noria. Their design is based on an appropriate choice of viscosity improving polymer and the amount incorporated.

The varying level of shear stability of the viscosity improving polymer incorporated in these multifunctional oils for engine, gearbox and hydraulic circuit will determine the respective levels of viscosity attained by this oil in each mechanism.

If we use a viscosity improving polymer that is very sensitive to shear, the viscosity will drop very rapidly, even in those mechanisms having a low shear rate: it will drop below the minimum viscosities required in the engine and the gearbox.

Conversely, if we use a polymer with a very high shear stability, the viscosity will remain high for a very long time even in those mechanisms having a high shear rate: it will take a very long time before the viscosity reaches in the best case a low enough value, as required for example in the hydraulic circuits. This can cause persistent cold starting problems for the lifting mechanisms operated by the hydraulic circuit.

If the behaviour of the polymer is intermediate, the adjustment parameters allowing simultaneous fulfilment of the 3 constraints of minimum viscosities in engine and gearbox, and maximum viscosity in the hydraulic system, are the amount and nature of the viscosity improving polymer used.

Most of the multifunctional oils currently in use are based on this principle. We therefore end up with compromises that exceed the limits of capacity for use of the existing multifunctional oils in three mechanisms at the same time.

Thus, the existing formulations of multifunctional oils do not allow them to simultaneously reach the performance levels expected in the various target mechanisms. Moreover, the performance levels are also not achieved in particular with respect to the high-temperature stability in the engines and the transmission and the cold starting of the hydraulics.

There is therefore a need for a single fluid whose performance is suitable for lubricating various mechanisms of a vehicle at the same time. In particular, there is a need for a single fluid that can be used for all three applications: engine, transmission and hydraulic circuit. There is also a need for the performance of this same single fluid to be adapted for good high-temperature stability in the engine and transmission and for cold starting of the hydraulics.

In fact, having a single fluid available for lubricating various mechanisms of a vehicle, relative to the use of several monofunctional oils, offers advantages in particular in terms of ease of maintenance and storage, servicing of the vehicle or of a fleet of vehicles, packaging and logistics.

This is true in particular for the large fleets of public service vehicles, which are often used on isolated sites and are subject to severe weather conditions, without adequate storage equipment.

Summary of the invention

Thus, the invention provides a lubricating composition comprising at least one oil of groups I to V and a mixture of at least two polymers having a difference in permanent shear stability index (PSSI), measured after the standardized KRL 20 hours test at 100°C of at least 25, and having a viscosity profile such that

(a) at 100°C after the Bosch-30 cycles test according to standard CEC-L-14-A-93 the viscosity of the final lubricating composition is greater than 9.0 cSt, preferably in the range from 9.0 to 12.0 cSt for an oil initially of grade 30, or else the viscosity of the final lubricating composition is greater than 12.0 cSt, preferably in the range from 12.0 to 15.0 cSt for an oil initially of grade 40, and

(b) at 100°C after the KRL-20 hours test according to standard CEC-L-45-A-99 the viscosity of the lubricating composition is greater than 8.5 cSt, preferably in the range from 8.5 to 11.0 cSt for an oil initially of grade 30 or 40, and

(c) at 40°C after the KRL-3 hours test, according to standard CEC-L-45-A-99 with the test duration reduced to 3 hours, the viscosity of the lubricating composition is less than 51 cSt, preferably in the range from 41 to 51 cSt for an oil initially of grade 30 or 40.

This formulation of multifunctional lubricant can be used for simultaneously lubricating various mechanisms of a motor vehicle. More particularly, this single lubricant is used for simultaneously lubricating at least three mechanisms, namely the engine, the gearbox and the hydraulic circuit, as it offers a viscosity profile adapted to the conditions of use required in each target mechanism.

For simultaneously lubricating the various target mechanisms of a motor vehicle, this single lubricant incorporates a mixture of polymers having different shear stabilities.

The nature and the respective amount of the different types of polymers are determined in such a way that the lubricating composition incorporating this mixture adapts very rapidly to the conditions of use required in each target mechanism, owing to its viscosity profile.

Thus, the lubricating composition includes at least 50 wt.%, based on the weight of the final composition, of at least one oil selected from the oils of groups I to V and at least 5%, preferably from 5 to 40%, or more preferably 5 to 15 wt.% based on the weight of the final composition, of a mixture comprising at least two different polymers of type "A", "B", or "C", the polymers of the mixture differing from one another in that they belong to a separate range of permanent shear stability index (PSSI) such that:

-the polymers of type "A" have a permanent shear stability index (PSSI), measured after the standardized KRL 20 hours test at 100°C, less than or equal to 40,

-the polymers of type "B" have a permanent shear stability index (PSSI), measured after the standardized KRL 20 hours test at 100°C, between 40 and 65 exclusive;

-the polymers of type "C" have a permanent shear stability index (PSSI), measured after the standardized KRL 20 hours test at 100°C, greater than or equal to 65;

said composition in which at least two polymers have a difference in PSSI measured after the standardized KRL 20 hours test at 100°C, of at least 25.

According to an embodiment, each of the polymers of the mixture is obtained from monomer units of a different chemical nature.

According to another embodiment, each polymer of the mixture is obtained from monomer units of identical chemical nature, and the polymers of the mixture differ from one another in that they belong to a different range of permanent shear stability index (PSSI) measured after the standardized KRL 20 hours test at 100°C and by at least one physicochemical characteristic selected from the number-average or weight-average molecular weight, the molecular weight distribution of said polymer characterized by the polydispersity index, the morphology of the three-dimensional network of said polymer characterized by its degree of crosslinking and/or branching.

According to an embodiment, the mixture comprises at least two polymers, the amount of one polymer relative to the total weight of the polymer mixture ranging from 10% to 90%.

According to an embodiment, the mixture comprises two polymers, one of type A and the other of type C, wherein, preferably, the weight ratio of the mixture of the two polymers A/C ranges from 10/90 to 90/10.

According to an embodiment, the lubricating composition according to the invention additionally comprises from 5 to 30 wt.%, relative to the weight of the final composition, of a package of functional additives and optionally less than 1 wt.%, preferably from 0.2% to 0.5 wt.%, relative to the weight of the final composition, of a pour point improver.

According to an embodiment, the polymers of the mixture are selected from polymers of the viscosity improver type and optionally from polymers of the pour point improver type.

Preferably, the viscosity improving polymers are selected from poly-alpha-olefins (PAO) with a kinematic viscosity at 100°C greater than 90 cSt, poly-isobutenes (PIB), polymeric esters, olefin copolymers (OCP), homopolymers or copolymers of styrene, of butadiene or of isoprene, polymethacrylates (PMAs).

Preferably, the pour point improving polymers are selected from polymethacrylates (PMAs).

Preferably, the polymers of type A are viscosity improving polymers selected from polymethacrylates, poly-alpha-olefins with a kinematic viscosity at 100°C greater than 90 cSt, polyisobutenes, polymeric esters.

Preferably, the polymers of type C are viscosity improving polymers selected from polymethacrylates, olefinic copolymers, hydrogenated styrene-isoprene copolymers, copolymeric esters.

Preferably, the polymers of type B are viscosity improving polymers of the polymethacrylate type.

According to another aspect the invention relates to a method of making a lubricating composition according to the invention wherein a mixture comprising at least two different polymers is incorporated in at least one oil of groups I to V optionally comprising a package of additives and optionally a pour point improver.

According to an embodiment, at least one of the polymers of the mixture is a viscosity improver, which is incorporated directly in the composition as a separate compound, independently of the package of additives.

According to another embodiment of the method, all or part of at least one of the viscosity improving polymers of the mixture is incorporated in the composition as an element of the package of additives.

According to another embodiment of the method, all or part of at least one of the viscosity improving polymers of the mixture is incorporated in the composition in the form of a diluent of the package of additives.

According to another aspect the invention relates to the use of a lubricating composition according to the invention as a single fluid for lubricating various mechanisms of motor vehicles.

Preferably, the single fluid is used for lubricating at least three mechanisms of motor vehicles, the engine, the gearbox and the hydraulic system of the vehicle.

More preferably, the single fluid is also used for lubricating the circuit for operating the brakes, the on-board compressor and optionally other ancillary mechanisms.

Detailed description of the embodiments of the invention

(A) Determination of shear stability:

The shear stability of a compound in an oil is characterized by the PSSI (Permanent Shear Stability Index), defined in standard ASTM-D6022-06 and calculated from the kinematic viscosities of said compound in the oil before and after a defined shearing process.

The formula for the PSSI of a polymer in an oil is given by:

PSSI = 100 x (Vi - Vc)/(Vi - Vo),

where:

- Vi = initial viscosity before shear of the oil + polymer mixture at 100°C.
- Vc = viscosity of the oil + polymer mixture after a shearing process at 100°C.
- Vo = initial viscosity before shear of the oil alone at 100°C.

Thus, the higher the PSSI of a polymer in the reference oil, the more said polymer is said to be sensitive to shear.

The shearing process selected for determining the PSSI of the polymers according to the present invention is the KRL 20 hours test, according to standard CEC-L-45-A-99.

The reference oil selected for measuring the PSSI of the polymers according to the present invention is a base oil from group III (according to the API classification) with a viscosity of 4.2 cSt at 100°C.

Hereinafter, and unless otherwise stated, the PSSI of a polymer will be the PSSI measured according to standard ASTM-D6022-06, measured in a diluent oil of group III (according to the API classification and with a viscosity of 4.2 cSt at 100°C, after the KRL 20 hours test, according to standard CEC-L-45-A-99).

In order to determine the composition of the mixtures of polymers incorporated in the lubricants according to the present invention, the applicant has defined the shearing conditions representative of each of the mechanisms considered and the levels of viscosity appropriate to each mechanism.

(B) Determination of the viscosity profile

1. Conditions of use as engine oil:

For engine lubricants, the CEC-L- 14-A-93 (or ASTM D6278) standard defines the test representative of the shearing conditions in the engine, known as the Bosch-30 cycles test.

The SAE J 300 classification defines the viscosity grades of fresh engine oils in particular by measurement of their kinematic viscosities at 40°C and/or 100°C.

An engine oil is of grade 30 according to SAE J 300 if its kinematic viscosity at 100°C is from 9.3 to 12.5 cSt.

An engine oil is of grade 40 according to SAE J 300 if its kinematic viscosity at 100°C is from 12.5 to 16.3 cSt.

Engine oils of grade 30 or 40 are generally used in so-called temperate climates.

An engine oil is of grade 50 according to SAE J 300 if its kinematic viscosity at 100°C is between 16.3 and 21.9 cSt. This type of oil is generally used in so-called hot climates.

As for the ACEA standards, they define in detail a certain number of supplementary specifications for engine oils, and in particular stipulate the maintaining of a certain level of viscosity for oils subjected in operation to shear in the engine.

Thus, according to ACEA series E2 or E3 the kinematic viscosity of engine oils of grade 30, 40 and 50, measured at 100°C, after the Bosch-30 cycles test, must be greater than 9.0, 12.0 and 15.0 cSt, respectively.

The lubricants according to the present invention that are usable as engine lubricants have a kinematic viscosity at 100°C greater than 9.0 cSt, preferably in the range from 9.0 to 12.0 cSt after the Bosch-30 cycles test according to the CEC-L- 14-A-93 standard for an oil initially of grade 30. These lubricants have a kinematic viscosity at 100°C greater than 12.0 cSt, preferably in the range from 12.0 to 15.0 cSt after the Bosch-30 cycles test according to the CEC-L-14-A-93 standard for an oil initially of grade 40. After this same test, these lubricants have a kinematic viscosity at 100°C which is greater than 15.0 cSt, preferably in the range from 15.0 to 20.0 cSt for an oil of grade 50.

2. Conditions of use as gearbox oil:

For gearbox lubricants, the CEC-L-45-A-99 standard defines the test representative of the shearing conditions in the gearbox, known as the KRL 20 hours test.

The applicant determined, from the data of tests for monitoring oils in service, that a viscosity of a lubricant at 100°C after the standardized KRL 20 hours test greater than 8.5 cSt was suitable for use in gearboxes in a temperate climate. Furthermore, a viscosity of a lubricant at 100°C after the standardized KRL 20 hours test greater than 11.0 cSt was suitable for use in a hot climate.

3. Conditions of use as hydraulic circuit oil:

The applicant also determined that the shearing conditions to which a lubricant is subjected in a hydraulic circuit could be represented by the KRL test according to the CEC-L-45-A-99 standard.

The applicant noticed that for operation in the hydraulic circuit while avoiding the problem of starting with fresh oil, in particular at low temperature, the viscosity of the lubricant, measured at 40°C, should be less than 51 cSt for temperate climates after the KRL test according to the CEC-L-45-A-99 standard, the duration of which is reduced from 20 hours to 3 hours. Similarly, the viscosity of the lubricant should be less than 75 cSt for hot climates after the KRL test according to the CEC-L-45-A-99 standard, the duration of which is reduced from 20 hours to 3 hours.

Thus, the lubricating compositions according to the present invention are suitable simultaneously for use in engines, gearboxes, and hydraulic circuits, as they have a viscosity profile which meets the following three cumulative conditions:

(a) at 100°C after the Bosch-30 cycles test according to the CEC-L-14-A-93 standard the viscosity of the final lubricating composition is greater than 9.0 cSt, preferably in the range from 9.0 to 12.0 cSt for an oil initially of grade 30, or else the viscosity of the final lubricating composition is greater than 12.0 cSt, preferably in the range from 12.0 to 15.0 cSt for an oil initially of grade 40, and

(b) at 100°C after the KRL 20 hours test according to the CEC-L-45-A-99 standard the viscosity of the lubricating composition is greater than 8.5 cSt, preferably in the range from 8.5 to 11.0 cSt for an oil initially of grade 30 or 40, and

(c) at 40°C after the KRL 3 hours test, according to the CEC-L-45-A-99 standard, the test duration of which is reduced to 3 hours, the viscosity of the lubricating composition is less than 51 cSt, preferably in the range from 41 to 51 cSt for an oil initially of grade 30 or 40.

Under these conditions, these compositions are particularly suitable for temperate climates.

According to a particular embodiment the lubricating compositions according to the present invention can also be used in hot climates and also meet the following conditions:

(1) the viscosity of said composition, measured at 100°C, after the Bosch-30 cycles test according to the CEC-L-14-A-93 standard representative of the shearing conditions in the engine, is between 15.0 and 20.0 cSt for a grade 50;

(2) the viscosity of said composition, measured at 100°C after the KRL 20 hours shearing test according to the CEC-L-45-A-99 standard representative of the shearing conditions in the gearbox, is between 11.0 and 14.0 cSt for an oil initially of grade 50;

(3) the viscosity of said composition measured at 40°C after the KRL 3 hours shearing test, according to the CEC-L-45-A-99 standard, is between 61 and 75 cSt for an oil initially of grade 50.

These conditions are determined by measurements of kinematic viscosity expressed in centistokes cSt (or equivalent mm^2/s) and according to known methods for which the standards were referred to earlier in the text.

(C) The base oils:

The base oils used in the formulation of lubricants according to the present invention are oils of groups I to V according to the API classification, of mineral, synthetic or natural origin, used alone or in mixture, one of the characteristics of which is insensitivity to shear, i.e. their viscosity does not change under shear. In the composition they represent at least 50 wt.%, relative to the total weight of the final composition. Moreover, their content can represent up to 95% or even 98% in the final composition.

(D) The package of additives:

The packages of additives used in the lubricating formulations according to the invention are conventional and are known by the skilled person and meet performance levels defined by, among others, the ACEA (Association des constructeurs Européens d'Automobiles – "European Automobile Manufacturers' Association") and/or the API (American Petroleum Institute).

They contain in particular and non-limitatively:

• antioxidants preventing degradation of the oil (for example amine or phenolic derivatives)

• antiwear and extreme-pressure agents protecting the rubbing surfaces by chemical reaction with the metallic surface (for example zinc dithiophosphate),

• dispersants ensuring that insoluble solid contaminants (for example PIB-succinimide) are kept in suspension and are removed,

• detergents, whether superbasic or not, preventing the formation of deposits on the surface of metal parts by dissolution of oxidation and combustion by-products (for example salicylates, phenates or sulphonates).

and at least 30 wt.% of a diluent consisting of base oil and optionally viscosity improving polymer.

The percentage by weight of the package of additives based on the weight of the final composition according to the invention is at least 5%, the diluent being included in this percentage.

(E) Compounds known as "pour point improvers"

The lubricating formulations according to the invention optionally comprise a pour point improver, which can be selected from the polymethacrylate (PMA) group with molecular weights generally between 5000 and 10000 daltons. It should be noted that these PMAs, when they are used as pour point improving additives, are typically present in the lubricating composition at a content of the order of 0.2 wt.%, based on the weight of the final lubricating composition. These pour point improving additives are generally supplied in the form of formulations diluted to a varying extent in a base oil. In particular, when these formulations are not very dilute, the PMAs are present at a content of the order of 60%.

Their use in the polymer mixture according to the present invention for adjusting the viscosity of the lubricant to a certain level after shear may require the use of higher contents.

(F) The polymer mixture in the lubricating composition.

The viscosity profile previously mentioned is in particular obtained by means of a mixture of at least two polymers selected from the polymers of types "A", "B" or "C" as defined below:

The polymers of types "A", "B" or "C" used as a mixture in the lubricants according to the present invention are preferably selected from polymers that improve the viscosity index or improve the pour point, as described above.

The viscosity improving polymers used in the present invention correspond to those used in the monofunctional oils. They are preferably selected from poly-alpha-olefins (PAO) with a kinematic viscosity at 100°C greater than 90 cSt, poly-isobutenes (PIB), polymeric esters, olefinic copolymers (OCP), homopolymers or copolymers of styrene, of butadiene or of isoprene, polymethacrylates (PMA).

The pour point improving polymers used in the present invention are preferably selected from polymethacrylates (PMA).

In general, the purpose of a viscosity improving polymer is to reduce the viscosity variations of the lubricant with the temperature. This temperature behaviour is characterized by the viscosity index V.I. of the lubricant. For an oil of high V.I. the stability of its viscosity as a function of temperature will be better.

The polymers incorporated in the lubricants according to the present invention have been classified in three groups according to the particular range of PSSI to which they belong:

1) The group of polymers of type "A" comprises the polymers that have a permanent shear stability index (PSSI), measured after the standardized KRL 20 hours test at 100°C, less than or equal to 40. These polymers have little sensitivity to shear: they are polymers whose PSSI after the standardized KRL 20 hours test at 100°C is

less than or equal to 40, preferably from 0 to 20. This type of polymer will make it possible to maintain the viscosity at a sufficient level in the engine and in the gearbox, but will also allow the viscosity to drop considerably in the hydraulic system.

The group of polymers of type "A" will include, in particular and non-limitatively, viscosity improving polymers selected from viscous poly-alpha-olefins (PAO) (with a viscosity at 100°C greater than 90 cSt), polyisobutenes (PIB), polymethacrylates (PMA). More specifically the polymers of type A are viscosity improving polymers selected from the polymethacrylates (Viscoplex 0-030, 0-110, 6-054, 8-220, 12-310), viscous poly-alpha-olefins (Spectrasyn 1000,300,150), polyisobutenes (Indopole 2100, Lubrizol 3174), polymeric esters (Kenjetlube 2700).

2) The group of polymers of type "B" comprises polymers that have a permanent shear stability index (PSSI), measured after the standardized KRL 20 hours test at 100°C, between 40 and 65 exclusive. These polymers of intermediate behaviour are said to be sensitive to shear: they are polymers whose PSSI after the standardized KRL 20 hours test at 100°C is between 40 and 65 exclusive. This type of polymer will provide the extra viscosity improver if necessary.

The group of polymers of type "B" includes in particular the viscosity improving polymers of the polymethacrylate type (Viscoplex 0-220, 3-500, 8-400, 8-251, 8-310).

3) The group of polymers of type "C" comprises polymers that have a permanent shear stability index (PSSI), measured after the standardized KRL 20 hours test at 100°C, greater than or equal to 65. These polymers are very sensitive to shear: they are polymers whose PSSI after the standardized KRL 20 hours test at 100°C is greater than or equal to 65, preferably from 65 to 100. This type of polymer will be sheared very rapidly in the hydraulic system, with a subsequent, long-lasting drop in viscosity of the lubricant in said system, thus avoiding the problems of low-temperature starting.

The group of polymers of type "C" includes, in particular and non-limitatively, the viscosity improving polymers selected from the category of olefinic copolymers, homopolymers or copolymers of styrene, of butadiene, or of isoprene. More specifically the polymers of type C are viscosity improving polymers selected from polymethacrylates (Viscoplex 7-710), olefinic copolymers (Paratone 8006, Lubrizol 7077), hydrogenated styrene-isoprene copolymers (Shellvis 151, 201, 261 and 301), copolymeric esters (Lubrizol 3702).

Thus, the viscosity profile of the composition according to the invention is obtained when at least two polymers of the mixture are selected from different ranges of PSSI.

The polymer mixtures used in the invention are constituted by at least two polymers, the polymers in the mixture differing from one another in that they belong to a different range of permanent shear stability index (PSSI) measured after the standardized KRL 20 hours test at 100°C.

This difference is characterized by the existence of a difference in PSSI of at least 25 between the PSSIs of at least two of the polymers present in the mixture.

Moreover, the resistance to shear of a polymer is not connected exclusively with its chemical nature. It can also be connected with physicochemical parameters. In fact parameters such as the molecular weights, molecular weight distribution (characterized in particular by the polydispersity index of the polymer), the degree of branching of the polymer chains, and generally the morphological characteristics of the polymer have an influence on its resistance to shear. Thus, certain compounds of identical chemical nature, such as the polymethacrylates for example, may belong to any one of the types "A", "B", or "C" described here.

Accordingly, a person skilled in the art will select the polymers of different types for use in the mixture in relation to their classification according to type A, B or C and their capacity for producing a lubricating composition, while meeting the three cumulative conditions as described above in the target viscosity profile.

This viscosity profile is also obtained when the polymers of the mixture differ either in their chemical nature or in their physicochemical nature.

Thus, when the polymers of the mixture differ in their chemical nature, this differentiation originates from the preparation of the polymers from monomer units of a different chemical nature. Thus, for example, a polymethacrylate is chemically different from a polyisobutene.

When the polymers of the mixture differ in their physicochemical nature, this differentiation arises from the preparation of the polymers from monomer units of identical chemical nature. In this case, each polymer of the mixture differs in that it belongs to a different range of permanent shear stability index (PSSI) as well as by at least one physicochemical characteristic selected from the (number-average or weight-average) molecular weight or the molecular weight distribution of said polymer characterized by its polydispersity index or the morphology of the three-dimensional network of said polymer characterized by its degree of crosslinking and/or branching. These differences in physicochemical nature are utilized according to techniques that are well known in the field of polymers.

According to a particular embodiment, the compositions according to the invention comprise a mixture in all proportions of two polymers of type A/B or A/C or B/C. Preferably, in said mixture, the amount by weight of one of the polymers of type A or B or C relative to the total weight of polymer in the mixture ranges from 10 to 90%. According to a preferred embodiment the compositions comprise a mixture of two polymers of type A and C in which the weight ratio A/C ranges from 10/90 to 90/10.

According to another particular embodiment the compositions according to the invention comprise a mixture in all proportions of the three polymers A, B and C. In this mixture, the amount by weight of one of the polymers of type A or B or C relative to the total weight of the polymers in the mixture can be at least 10% and at most 80%. Thus, preferably we can have mixtures A/B/C whose proportions by weight are 10/10/80 or 10/80/10 or 80/10/10 and all intermediate proportions.

According to an embodiment, the compositions according to the invention comprise a mixture of the three polymers A, B and C in which polymer A is present in an amount from 30 to 45 wt.%, polymer B is present in an amount from 1 to 20 wt.% and polymer C is present in an amount from 30 to 45 wt.%, these percentages being expressed relative to the total weight of the polymers.

More particularly, the mixtures of polymers used in the invention as defined above represent at least 5%, preferably from 5 to 40%, more preferably 5 to 15 wt.%, based on the weight of the final lubricating composition.

According to an embodiment the minimum amount of a polymer relative to the total weight of the final composition is 1%.

In the field of lubricants all these percentages generally correspond to polymers that comprise at least 5% of polymeric active substance, the remainder being represented by a base oil used as a diluent. Moreover, in certain cases when the polymer requires little or no dilution (for example the PAOs), these percentages can be up to 100% of polymeric active substance.

Consequently, these lubricants adapt very rapidly to the conditions of use required in each mechanism.

In order to prepare the lubricating composition according to the invention, a mixture of at least two polymers of type A, B or C is incorporated, generally at a temperature between 20 and 100°C and at atmospheric pressure, in at least one oil of groups I to V optionally comprising a package of additives and optionally a pour point improver.

The polymers of type "A", "B" or "C" according to the present invention can be incorporated in the composition in the form of separate components, or else they can be introduced as a component of the package of additives, as an additive or a diluent.

Thus, the lubricating compositions according to the invention are prepared by incorporating at least one of the viscosity improving polymers of type A, B, or C directly in the composition as a separate additive, independently of the package of additives.

According to another embodiment, all or part of at least one of the viscosity improving polymers of type A, B, or C is incorporated in the lubricant as an element of a package of additives.

According to another embodiment all or part of at least one of the viscosity improving polymers of type A, B, or C is incorporated in the lubricant as a diluent in the package of additives.

The compositions according to the invention are used as a single lubricant in various mechanisms of motor vehicles simultaneously, in particular in mechanisms having different shear rates. Thus, the compositions according to the invention have a performance that is particularly well suited for good high-temperature stability in the engine and the transmission and for cold starting of the hydraulic system.

Examples: The examples given below are for the purpose of illustrating the invention without limiting its scope.

The mixtures were prepared with stirring at 80°C in 1-litre bottles. The ASTM D445 standard is applied for the determination of kinematic viscosities. Two samples of lubricants were prepared, of grade 40 and 30 respectively according to the SAE J 300 classification.

Example 1:

A lubricant was prepared containing 50 wt.% of a base oil of group IV having a viscosity of 2 cSt at 100°C, and 14.25 wt.% of a commercial package of additives referenced as supplier 1. This package of additives did not contain any polymers of type "A", "B" or "C" according to the present invention, and the diluent was constituted by base oil.

A mixture consisting of:

31 wt.% of a poly-alpha-olefin of type "A" according to the present invention, having a PSSI of 6, and

4.75 wt.% of a formulation containing 35% of active substance represented by a copolymeric ester of type "C" according to the present invention, having a PSSI of 93 was then added to said lubricant.

The lubricant thus prepared was of grade 40 according to the classification SAE J300.

Example 2:

A lubricant was prepared containing 77.5 wt.% of a base oil of group IV with a viscosity of 4.2 cSt at 100°C, and 14.50 wt.% of a commercial package of additives referenced as supplier 2. This package of additives did not contain any polymers of type "A", "B" or "C" according to the present invention and the diluent was constituted by base oil.

A mixture consisting of:

3.5 wt.% of a heavy poly-alpha-olefin of type "A" according to the present invention, having a PSSI of 35, and

1 wt.% of a formulation containing 63% of active substance represented by a PMA polymer of type "B" according to the present invention, having a PSSI of 63, and

3.5 wt.% of a formulation containing 10.8% of active substance represented by a hydrogenated styrene-isoprene copolymer of type "C" according to the present invention, having a PSSI of 90 was then added to said lubricant.

The lubricant thus prepared was of grade 30 according to the SAE J300 classification.

The following table gives the viscosity values in cSt of these two lubricating compositions:

at 100°C after the KRL-20 hours test according to the CEC-L-45-A-99 standard, at 100°C after the Bosch-30 cycles test according to the CEC-L- 14-A-93 standard,

at 40°C after the KRL-3 hours test, according to the CEC-L-45-A-99 standard with the test duration reduced to 3 hours.

Table I:

		Example 1	Example 2
Base oils			
Group IV with a viscosity of 2 cSt (% of total weight of lubricant)		50.00	
Group III with a viscosity of 4.2 cSt			77.50
Packages of additives			
supplier 1		14.25	
supplier 2			14.50
VI improving polymers/	PSSI		
Type "A" Spectrasyn 150/	6	31.00	
Type "A" Spectrasyn 1000/	35		3.50
Type "C" Lubrizol 3702/	93	4.75	
Type "B" Visco 8-400/	63		1.00
Type "C" ShellVis 261/	90		3.50
results			
Single lubricating composition		Grade 40	Grade 30
Viscosity at 40°C after KRL 3H (hydraulics) in cSt		50.00	51.00
Viscosity at 100°C after KRL 20H (gearbox) in cSt		9.80	8.50
Viscosity at 100°C after Bosch 30 cycles (engine) in cSt		12.00	11.20

Spectrasyn 150 is a poly-alpha-olefin (PAO)

Spectrasyn 1000 is a poly-alpha-olefin (PAO)

Lz 3702 is a copolymeric ester

Viscoplex 8-400 is a polymethacrylate

SV 261 is a hydrogenated styrene-butadiene copolymer

The packages of additives from suppliers 1 and 2 are commercial packages of additives for engine oil diluted in oils of group I to III and not containing any polymer of types A, B or C according to the present invention.

These packages make it possible in particular to formulate lubricants for engines having performances at level E3 of the ACEA.

AMENDED CLAIMS

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CLAIMS

1. A lubricating composition comprising at least one oil of groups I to V and a mixture of at least two polymers having a difference of permanent shear stability index (PSSI), measured after the standardized KRL 20 hours test at 100°C of at least 25, and having a viscosity profile such that

(a) at 100°C after the Bosch-30 cycles test according to the CEC-L-14-A-93 standard the viscosity of the final lubricating composition is greater than 9.0 cSt, preferably in the range from 9.0 to 12.0 cSt for an oil initially of grade 30, or else the viscosity of the final lubricating composition is greater than 12.0 cSt, preferably in the range from 12.0 to 15.0 cSt for an oil initially of grade 40, and

(b) at 100°C after the KRL-20 hours test according to the CEC-L-45-A-99 standard the viscosity of the lubricating composition is in the range from 8.5 to 11.0 cSt for an oil initially of grade 30 or 40, and

(c) at 40°C after the KRL-3 hours test, according to the CEC-L-45-A-99 standard with the test duration reduced to 3 hours, the viscosity of the lubricating composition is less than 51 cSt, preferably in the range from 41 to 51 cSt for an oil initially of grade 30 or 40.

2. A lubricating composition comprising at least one base oil of groups I to V, and a mixture of at least two polymers having a difference of permanent shear stability index (PSSI), measured after the standardized KRL 20 hours test at 100°C, of at least 25, and having a viscosity profile such that:

(1) the viscosity of said composition, measured at 100°C after the Bosch-30 cycles test according to the CEC-L-14-A-93 standard representative of the shearing conditions in the engine, is between 15.0 and 20.0 cSt for a grade 50;

(2) the viscosity of said composition, measured at 100°C after the KRL 20 hours shearing test according to the CEC-L-45-A-99 standard representative of the shearing conditions in the gearbox, is between 11.0 and 14.0 cSt for an oil initially of grade 50

(3) the viscosity of said composition measured at 40°C after the KRL 3 hours shear test, according to the CEC-L-45-A-99 standard, is between 61 and 75 cSt for an oil initially of grade 50,

3. The lubricating composition according to claim 1 or 2 comprising at least 50 wt.%, based on the weight of the final composition, of at least one oil selected from the oils of groups I to V and at least 5%, preferably from 5 to 40%, or more preferably 5 to 15 wt.%, based on the weight of the final composition, of a mixture comprising at least two different polymers of type "A", "B", or "C", the polymers of the mixture differing from one another in that they belong to a separate range of permanent shear stability index (PSSI) such that:

-the polymers of type "A" have a permanent shear stability index (PSSI), measured after the standardized KRL 20 hours test at 100°C less than or equal to 40,

-the polymers of type "B" have a permanent shear stability index (PSSI), measured after the standardized KRL 20 hours test at 100°C, between 40 and 65 exclusive;

-the polymers of type "C" have a permanent shear stability index (PSSI), measured after the standardized KRL 20 hours test at 100°C greater than or equal to 65;

said composition in which at least two polymers have a difference in PSSI, measured after the standardized KRL 20 hours test at 100°C, of at least 25.

4. The lubricating composition according to claim 3, wherein each of the polymers of the mixture is obtained from monomer units of a different chemical nature.

5. The lubricating composition according to claim 3 or 4, wherein each polymer of the mixture is obtained from monomer units of identical chemical nature, and the polymers of the mixture differ from one another in that they belong to a different range of permanent shear stability index (PSSI) measured after the standardized KRL 20 hours test at 100°C and by at least one physicochemical characteristic selected from the number-average or weight-average molecular weight, the molecular weight distribution of said polymer characterized by the polydispersity index, the morphology of the three-dimensional network of said polymer characterized by its degree of crosslinking and/or branching.

6. The lubricating composition according to one of claims 3 to 5, wherein, in the mixture comprising at least two polymers, the amount of one polymer relative to the total weight of the polymer mixture ranges from 10% to 90%.

7. The lubricating composition according to one of claims 3 to 6, wherein the mixture comprises two polymers, one of type A and the other of type C.

8. The lubricating composition according to claim 7, wherein the weight ratio of the mixture of the two polymers A/C ranges from 10/90 to 90/10.

9. The lubricating composition according to one of claims 3 to 8, additionally comprising from 5 to 30 wt.%, relative to the weight of the final composition, of a package of functional additives and optionally less than 1 wt.%, preferably from 0.2% to 0.5 wt.%, relative to the weight of the final composition, of a pour point improver.

10. The lubricating composition according to one of claims 3 to 9, wherein the polymers of the mixture are selected from polymers of the viscosity improver type and optionally from polymers of the pour point improver type.

11. The lubricating composition according to claim 10, wherein the viscosity improving polymers are selected from poly-alpha-olefins (PAO) with a kinematic viscosity at 100°C greater than 90 cSt, poly-isobutenes (PIB), polymeric esters, olefinic copolymers (OCP), homopolymers or copolymers of styrene, of butadiene or of isoprene, polymethacrylates (PMA).

12. The lubricating composition according to claim 10, wherein the pour point improving polymers are selected from polymethacrylates (PMA).

13. The lubricating composition according to one of claims 3 to 12, wherein the polymers of type A are viscosity improving polymers selected from polymethacrylates, poly-alpha-olefins with a kinematic viscosity at 100°C greater than 90 cSt, polyisobutenes, polymeric esters.

14. The lubricating composition according to one of claims 3 to 12, wherein the polymers of type C are viscosity improving polymers selected from polymethacrylates, olefinic copolymers, hydrogenated styrene-isoprene copolymers, copolymeric esters.

15. The lubricating composition according to one of claims 3 to 12, wherein the polymers of type B are viscosity improving polymers of the polymethacrylate type.

16. A method of making the lubricating composition according to one of claims 1 to 15, wherein a mixture comprising at least two different polymers is incorporated in at least one oil of groups I to V optionally comprising a package of additives and optionally a pour point improver.

17. The method according to claim 16 of making the lubricating composition according to any one of claims 1 to 15, wherein at least one of the polymers of the mixture is a viscosity improver which is incorporated directly in the composition as a separate compound, independently of the package of additives.

18. The method according to claim 16 of making the lubricating composition according to any one of claims 1 to 15, wherein all or part of at least one of the viscosity improving polymers of the mixture is incorporated in the composition as an element of the package of additives.

19. The method according to claim 16 of making the lubricating composition according to one of claims 1 to 15, wherein all or part of at least one of the viscosity improving polymers of the mixture is incorporated in the composition in the form of a diluent of the package of additives.

20. The use of the lubricating composition according to any one of claims 1 to 15 as a single fluid for lubricating various mechanisms of motor vehicles.

21. The use according to claim 20, wherein the single fluid is used for lubricating at least three mechanisms of motor vehicles: the engine, the gearbox and the hydraulic system of the vehicle.

22. The use according to claim 20 or 21, wherein the single fluid is also used for lubricating the circuit for operating the brakes, the on-board compressor and optionally other ancillary mechanisms.