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(54) **Water/vegetable oil emulsion**

(57) The present invention relates in general terms to a stabilizing composition for water/light vegetable oil emulsions, characterized in that it comprises a particular non-ionic surfactant of formula (I) and/or (II). The water/light vegetable oil emulsions thus stabilized have excellent characteristics, above all in terms of life span and homogeneity, and can be used as a vegetable fuel, for example, for internal combustion engines, turbines, burners, boilers or the like.

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Description

[0001] The present invention relates in general terms to a stabilizing composition for water/light vegetable oil emulsions, characterized in that it comprises at least one non-ionic surfactant of formula (I) and/or (II), as described below in detail. The water/light vegetable oil emulsions thus stabilized exhibit excellent characteristics, above all in terms of life span, homogeneity and ability to sub-micronize micelles, and can be employed as a vegetable fuel, for example for internal combustion engines, turbines, burners, boilers or the like.

Background art

[0002] It is well known that internal combustion engines can be supplied with fuels based on vegetable or animal oil or petroleum derivatives, suitably mixed and emulsified with ultrapure water. In this manner, in fact, it is possible to obtain a fuel that produces a smaller amount of nitrogen oxides (generally indicated as NOx) in the combustion chamber, as well as lower emissions of CO gas, CO_2, and particulate matter, thus contributing to safeguarding health and the environment. When mixed and emulsified in suitable amounts with a fuel, water is capable of reducing the combustion temperature and in this manner reduces the emission of polluting nitrogen oxides. The engine's efficiency is also improved compared to when fuel alone is used, since the water particles, uniformly incorporated in the oily matrix, explode on being injected into the combustion chamber and instantly vaporize, atomizing the fuel itself and additionally producing (by thermolysis) hydrogen and oxygen ions. The result is an improved combustion which makes the engine more efficient, as well as enabling a lower consumption of fuel. In this regard, the use of fuels obtained by emulsions of vegetable oils and water is well known in the art. Depending substantially on the type and content of fats present and viscosity, vegetable oils can be classified as light or heavy oils. Light oil generally means an oil that exhibits low fluidity, such that at room temperature (understood as comprised between around 20 °C and around 35 °C) it is in liquid form.

[0003] Analogously, heavy oils are compounds that exhibit lower fluidity (i.e. a more solid character) and at the same temperatures appear as solid or semi-solid substances. Examples of light vegetable oils are: soybean oil, sunflower oil and rapeseed oil, whereas examples of heavy vegetable oils are: palm oil, cashew oil and the like.

[0004] It should be emphasized that said light and heavy oils, having mutually different physical and chemical characteristics, can have specific uses which are closely tied to their nature and physicochemical behaviour.

[0005] However, one of the biggest problems tied to the preparation of fuels in the form of a water/oil emulsion is related to the stability, homogeneity and size of the micelles of the obtainable emulsions, which do not always reach acceptable levels in terms of production yield on a large scale.

[0006] One of the most widely used methods for forming said emulsions is by mechanical means, involving the mixing of the oily component with water, using a mechanical process. However, the mechanical methods commonly used are often costly and are not always able to ensure optimal results in terms of stability and homogeneity of the final emulsion. The obtained emulsions, in fact, exhibit a reduced stability, sometimes associated with a low homogeneity, which can thus compromise their efficiency as fuels for internal combustion engines.

[0007] To complete the preparation by mechanical means, there are several processes known in the art which involve the use of stabilizing chemical additives and they can be used, for example, to form the so-called "white diesel".

[0008] By way of example, WO2004099350 and WO2011054817 describe an additive for diesel fuel which comprises a mixture of amine surfactants, derived from polyisobutenyl succinic anhydride (PIBSA).

[0009] There thus remains a need to find a composition that is useful as a stabilizing additive for water/light vegetable oil emulsions and can ensure high stability over time, along with a high efficiency and low emission of combustion gases.

Summary of the invention

[0010] In a first aspect, the invention relates to a composition for water/light vegetable oil emulsions, comprising at least: a dispersing element, a lubricant agent, a solvent and a cetane improver, and characterized in that it contains at least one surfactant of formula **(I)** and/or **(II):**

$$R\text{-}(CH{=}CH)\text{-}R'\text{-}R'' \qquad \textbf{(I)}$$

$$R\text{-}Ph\text{-}O\text{-}(CH_2\text{-}CH_2\text{-}O)_n\text{-}H \qquad \textbf{(II)}$$

wherein:

R and R' are each independently a linear or branched C_4-C_8 alkyl group, optionally substituted;
R" is selected from among: -OH, -O-$(CH_2$-CH_2-O$)_n$-H, -COOH, and -COO-$(CH_2$-CH_2-O$)_n$-H;
n is an integer comprised between 2 and 5;

Ph is a bivalent phenyl group, optionally substituted;
n' is less than or equal to 40.

[0011] In a further aspect the invention relates to the use of said composition in the preparation of a water/light vegetable oil emulsion.

[0012] In another aspect, the invention relates to a process for preparing the above-mentioned water/oil emulsion, said process comprising the steps of:

- mixing the above-described stabilizing composition with water; and
- emulsifying the thus obtained mixture with a light vegetable oil.

[0013] In an additional aspect, the invention relates to an emulsion obtained (or obtainable) with the above-mentioned process, preferably in the form of a nanoemulsion.

[0014] In a final aspect, the invention also relates to the use of the aforesaid emulsion as a fuel for internal combustion engines, preferably turbines, burners, boilers or the like.

Detailed description

[0015] The term "light vegetable oil" comprises in its meaning an oil of vegetable origin having a fluidity at a temperature comprised between 20 °C and 35 °C which is similar to that of a liquid. Light oil means one having at 25 °C a viscosity of less than 50 cSt, as measured, for example, with a Digital Viscometer.

[0016] Examples of such oil are: rapeseed, soybean and sunflower oil and the like.

[0017] The term "emulsion" indicates a heterogeneous system consisting of two immiscible liquid substances, one intimately dispersed in the other in the form of minute drops. Depending on the diameter (larger or smaller than 100 nm) of these latter, it is intendeed micro- or nanoemulsions.

[0018] The term "NO_x" is meant to indicate nitrogen oxides, for example (NO, NO_2), which develop as a result of the combustion of fuels used in common internal combustion engines, such as, for example, natural oil-based fuels. The term "linear or branched C_4-C_8 alkyl group, optionally substituted" indicates a linear or branched alkyl residue comprising 4 to 8 carbon atoms, which may be substituted, for example, with carbonyl, carboxyl or heteroatomic groups. Examples of such groups are: butyl, isobutyl, pentyl, isopentyl, hexyl, and the like. Analogously, C_1-C_8 and C_{12}-C_{20} indicate linear or branched alkyl groups having 1-8 and 12-20 carbon atoms, respectively.

[0019] The term "bivalent phenyl group" indicates an aromatic residue with 6 carbon atoms, wherein, in formula (II), it is substituted with the -R group and the -O-(CH_2-CH_2-O)$_n$,-H residue with an ortho-ortho, ortho-meta or ortho-para pattern.

[0020] The present composition is useful as an additive composition, since it enables water/light vegetable oil emulsions to be obtained which are particularly stable over time, and can be used, for example, as a bio-fuel for internal combustion engines, turbines and the like. Advantageously, the emulsion obtained exhibits excellent properties in terms of efficiency, consumption, and environmental impact.

[0021] In this regard, it should be noted that, thanks to the present invention, it is possible to considerably reduce the emission of toxic gases such as CO and NOx, particulate matter and the like, whilst maintaining an excellent stability of the emulsions, as indicated in the experimental part herein included. The Applicants have in fact found that by virtue above all of the presence of the surfactants (I) and/or (II), the stabilizing composition of the invention enables high efficiency values to be obtained, while drastically reducing the amount of waste substances emitted. In particular, the surfactants of formula (I) and/or (II) contained in the composition of the invention, thanks to the presence of a lipophilic head and hydrophobic tail, are capable of lowering the surface tension of water and a light vegetable oil, thus facilitating the miscibility between the two liquids. In practical terms, the surfactant is able to position itself between the aqueous phase and the oily one, drastically lowering the interface tension and stabilizing the water/oil system as a result.

[0022] Furthermore, the present surfactants (I) and/or (II) also exert a protective function against corrosion on the metal structures of the engine, as well as improving the lubricating power.

[0023] The selected surfactant of the invention generally has an HLB (hydrophilic-lipophilic balance) comprised between 2 and 20 (for a general definition of HLB see, for example, Griffin WC "Classification of Surface-Active Agents by 'HLB'" Journal of the Society of Cosmetic Chemists 1 (1949): 311).

[0024] In a preferred embodiment, the present composition comprises at least one surfactant of formula (I) and/or (II):

R-(CH=CH)-R'-R" **(I)**

R-Ph-O-(CH_2-CH_2-O)$_n$,-H **(II)**

wherein:

R and R'	are each independently a linear or branched C_4-C_8 alkyl group, optionally substituted;
R"	is selected from: -OH, -O-$(CH_2$-CH_2-O$)_n$-H,-COOH, and -COO-$(CH_2$-CH_2-O$)_n$-H;
n	is an integer comprised from 2 and 5;
Ph	is a bivalent phenyl group, optionally substituted;
n'	is less than or equal to 40.

[0025] Preferably, n' is 9, 10, or 40; even more preferably n' is 9 or 10.

[0026] Preferably, R and R' are independently a linear or branched C_6-C_8 group. In a particularly preferred embodiment, R is equal to R' and even more preferably both are a linear or branched C_6-C_8 group.

[0027] Particularly preferred are stabilizing compositions of the invention comprising an unsaturated alcohol surfactant of formula (I), wherein R" is -OH, or an ethoxylated alcohol of formula (I), wherein R" is -O-$(CH_2$-CH_2-O-$)_n$-H, and wherein n is defined as above. Equally preferred are stabilizing compositions comprising unsaturated fatty acid-derived surfactants of formula (I), wherein R" is selected from -COOH and -COO-$(CH_2$-CH_2-O$)_n$-H, and wherein n is defined as above.

[0028] In a further preferred embodiment, the stabilizing composition of the invention comprises an alkyl phenol ethoxylate surfactant of formula (II) as above defined, especially useful in the event that the selected light oil has short molecular chains.

[0029] In one embodiment, the present stabilizing composition for water/light vegetable oil emulsions comprises at least two surfactants, preferably both of formula (I). In the present composition, the presence of a surfactant comprising esterified PEG, i.e. a compound of formula (I), wherein R" is -COO-$(CH_2$-CH_2-O)n-H, and an ethoxylated fatty alcohol of formula (I), wherein R and R' are C_6-C_8, is particularly preferred.

[0030] The selected surfactant can be used in the present composition in amounts comprised between 30% and 80% by weight.

[0031] In addition to the surfactant of formula (I) and/or (II) as specified above, the stabilizing composition of the invention also comprises: at least one dispersing element, at least one lubricant agent, at least one solvent and at least one cetane improver, as described below in detail.

[0032] The dispersing agent (or emulsifier) maintains the drops of the emulsion separate, stabilizing them. The selected dispersing agent is generally a polymer molecule obtained by reacting maleic anhydride with polyisobutylene. The different number of moles participating in the reaction enables polyisobutylene succinic anhydride of a different molecular weight to be obtained as the reaction product. The stabilizing composition of the invention contains a polymer with an average molecular weight comprised between 1300 and 2400 (sold, for example, by Innospec). The dispersing agent is used in the present composition in amounts comprised from 10% and 50% by weight, relative to the total weight of the composition, preferably between 20% and 40% by weight.

[0033] According to a further embodiment, the dispersing agent can be used as it is or, alternatively, in admixture with an organic solvent. In the latter case, in fact, it is possible to improve the ease of handling of the present composition.

[0034] In this regard, examples of preferred solvents are selected from: branched paraffins, isomeric linear paraffins of trimethylbenzene and aromatic and non-aromatic solvents, naphtha, kerosene and derivatives thereof, preferably in amounts comprised between 10 and 40% relative to the dispersing agent, more preferably between 20 and 35%.

[0035] The lubricant agent present in the stabilizing composition of the invention is represented by TOFA (tall oil fatty acid) which is an unsaponifiable sterols, resin acids, fatty acids and alcohols and alkyl derivatives of hydrocarbons in different percentages.

[0036] The lubricant agent is useful above all to permit less corrosion of mechanical parts due to the presence of water. The presence of this component in the invention enables it to be used also, and not only, in high pressure direct injection engines of the latest generation, for example of the common-rail type.

[0037] The solvent of the present stabilizing composition is used both as a matrix within the present stabilizing composition, and as a fluidizer within the emulsion that is formed between the light vegetable oil and water. Said solvent can be, for example, an aromatic or aliphatic organic derivative, preferably selected from among: kerosene, trimethylbenzene isomers (known as Solvesso), branched paraffins, linear paraffins, and alcohols having 2 to 6 carbon atoms, for example ethanol, butanol, isobutanol, pentanol, hexanol and the like.

[0038] The solvent can be used in the present stabilizing composition in amounts preferably comprised between 0.05% and 30%, the interval between 5 and 20% being particularly preferred.

[0039] As regards the "cetane improver", it is a component capable of increasing the cetane number of the emulsion, making it possible to recover the ignition quality that is lost in a typical oil/water emulsion because of the presence of water. The cetane number is known to the person skilled in the art as an indicator of the behaviour of fuels in the ignition phase (flash point). This number refers to the readiness of the fuel to ignite, so that the higher the cetane number, the greater such readiness.

[0040] Examples of cetane improver components usable in the composition of the invention are mixtures of the cetane

compound ($C_{16}H_{34}$, CAS No. 544-76-3) with nitrate salts, peroxides and the like. Cetane/2-ethylhexylnitrate mixtures and cetane/aqueous ammonium nitrate mixtures are particularly preferred. Equally preferred are mixtures of cetane with cumene peroxide or tert-butyl peroxide. The cetane improver is used in the stabilizing composition of the invention in amounts comprised between 0.05 and 30% by weight, relative to the total weight of the composition.

[0041] The percentages of the components of the stabilizing composition of the invention can be varied in the intervals indicated, generally depending on the type and/or purity of the light vegetable oil used, in order to obtain an emulsion that has the desired characteristics, for example in terms of efficiency and/or emission of greenhouse gases, NO_x, particulate matter or the like. It has been noted, in fact, that thanks to the versatility of the present composition, it is possible to obtain stabilized emulsions which are useful as a vegetable fuel by using different types of light vegetable oils, also with low purity, or even earmarked for disposal. In any case, in fact, by suitably dosing the components of the composition of the invention, it is possible to obtain emulsions having specific technical characteristics in terms of efficiency, stability and environmental impact, such that their use as a vegetable fuel is not substantially prejudiced.

[0042] The present composition can be conveniently prepared by mixing the above-described components, preferably by homogenization, even for a very short period of time which typically depends on the type of mixer used, and the relative amounts of the individual components. By way of example, when the mixing of components takes place using a homogenizer at a speed of about 4500-4000 revolutions per second, the preparation time of the composition of the invention is comprised between around 5 and 10 seconds. The composition thus obtained is therefore ready to be used to stabilize water/light vegetable oil emulsions for use as fuel, as described below in detail. The composition of the invention is preferably used as an additive for "on-demand" preparations of water/light vegetable oil emulsions, i.e. ready for use and are employable shortly after their preparation.

[0043] The present composition enables the obtainment of a stability of the emulsions greater than 96 hours, whilst maintaining an excellent homogeneity of the emulsion during the use. By stabilities greater than 96 hours it is here meant that once that time has elapsed, the water/light vegetable oil emulsion does not exhibit any substantial physicochemical modifications (detectable, for example, through the formation of a precipitate), such as to negatively influence or compromise the use thereof.

[0044] In a further embodiment, the stabilizing composition of the invention can further comprise additional components, selected, for example, from: dyes, co-surfactants and the like.

[0045] As indicated above, the present composition, characterized in that it comprises at least one surfactant of formula (I) and/or (II), is usable as an additive in the preparation of a water/light vegetable oil emulsion. The latter is particularly suitable for use as fuel for internal combustion engines, turbine, boilers and the like.

[0046] Therefore, in a further aspect, the invention relates to a process for preparing a water/light vegetable oil emulsion which comprises the steps of:

a) mixing the above-described stabilizing composition comprising at least one surfactant of formula (I) and/or (II) with water; and
b) emulsifying the mixture thus obtained with the selected light vegetable oil.

[0047] The mixing according to step a) preferably takes place between the stabilizing composition and deionized water, even more preferably having a maximum conductivity of about 10 μS/cm.

[0048] Mixing can take place using machinery commonly used in the art, for example with the use of mixers. Preferably, step a) takes place at a temperature comprised between about 45 °C and about 65 °C, for a frame of time that can typically vary depending on the amounts of reagents used.

[0049] At the end of the mixing, it is obtained a homogeneous mixture that is thus emulsified with the selected light vegetable oil, according to step b) of the present process. Said vegetable oil is preferably selected from: rapeseed, sunflower and soybean oil. Step b) can be carried out using emulsifiers, for example a NanotechLab multi-stage mixer.

[0050] During the emulsion step b), the temperature is preferably comprised between about 45 °C and about 75 °C.

[0051] The process for preparing the emulsion of the invention generally requires an amount of time ranging from a few minutes to a few hours; if necessary, the emulsion can be produced directly on the fuel supply line. In this manner it is possible to obtain, in a short frame of time, water/light vegetable oil emulsions which are stabilized by the composition of the invention and can lead to a high efficiency of the engines they are used in as fuels.

[0052] Therefore, an additional aspect of the invention is a water/light vegetable oil emulsion obtained (or obtainable) with the above-described process.

[0053] In one embodiment of the invention, the emulsion is in the form of a micro- or nanoemulsion, understood as comprising water particles having an average diameter comprised between around 10 nm and around 200 nm, preferably comprised between around 10 nm and around 100 nm. The use of 10-100 nm nanoemulsions is particularly advantageous for fuelling internal combustion engines, since the nanoparticles of water make it possible to obtain large surface areas, contributing to increasing the efficiency and stability of the emulsion obtained, as well as favouring thermolysis of the water.

[0054] The present emulsion preferably comprises an amount of water of less than 25% by weight, understood as %

relative to the total weight of the emulsion.

[0055] As regards the light vegetable oil, this is present in the emulsion of the invention in an amount comprised between around 75% and around 95%.

[0056] Preferred emulsions further comprise the stabilizing composition as described above in detail in amounts comprised between 0.05% and 2.5%, preferably comprised between 0.1 and 1%.

[0057] Advantageously, in fact, even small percentages of the stabilizing composition can be sufficient to obtain stable, homogeneous emulsions with characteristics emissions and efficiency, that are acceptable for a use as a fuel.

[0058] The invention will be now described with the following non-limiting experimental part.

Experimental part

Example 1: preparation of an oil/water emulsion stabilized with the additive of the invention (general method)

[0059] The dispersing element is preheated to a temperature comprised between 60 and 70 °C and is then dissolved in the selected solvent before being mixed with the other components of the additive.

[0060] The mixing of the components takes place by IKA T25 digital homogenization for just few minutes, at a speed of around 8000 min-1.

[0061] During preparation of the emulsion, the additive is added to the deionized water; then a first mixing takes place, followed by the addition of the vegetable oil, and, finally, the system is mixed again.

[0062] The following additives are prepared; they enable stabilized emulsions with 12% water and 0.4% additive to be obtained:

Additive 1.1

[0063]

20% individual dispersing element, molecular weight in paraffin (35% by weight);
65% surfactant (50% ethoxylated fatty alcohol + 50% esterified PEG);
5% trimethylbenzene isomers;
5% 2-ethylhexyl nitrate;
5% lubricant agent: tall oil.

Additive 1.2

[0064]

20% dispersing element, individual molecular weight in paraffin (35% by weight);
70% surfactant (50% ethoxylated fatty alcohol + 50% esterified PEG);
5% diesel;
5% 2-ethylhexyl nitrate;
5% lubricant agent: tall oil.

Additive 1.3

[0065]

30% dispersing element, individual molecular weight in diesel (35% by weight);
60% surfactant (esterified PEG);
5% branched paraffin;
5% 2-ethylhexyl nitrate;
5% lubricant agent: tall oil.

Additive 1.4

[0066]

20% dispersing element, individual molecular weight in paraffin (35% by weight);
60% surfactant (50% ethoxylated fatty alcohol + 50% esterified PEG);

10% trimethylbenzene isomers;
10% ammonium nitrate 60%;
5% lubricant agent: tall oil.

Example 2: stability tests on the additive of the invention, compared to a known additive comprising the amine surfactant EMPILAN AMT7.

[0067] In order to evaluate the characteristics and effectiveness of the product studied, a series of preliminary analyses were conducted to compare the 1.1 additive of example 1 with the commercially available additive S1 containing an ethoxylated amine Empilan® AMT7 as the surfactant (available from Huntsman).

[0068] Three emulsions were prepared for each additive. Every emulsion had a water concentration of 12% by weight and a variable concentration of additive by weight of: 0.5%; 1.2%; 2.5%.

[0069] A volume of 40 ml for each emulsion was placed in a test tube and the volume (mL) of sediment formed was recorded weekly for a month. The established criteria for determining the effectiveness of the product are:

- Sediment no greater than 2mL; and
- Time it takes for the latter to form greater than 96 hours.

[0070] The results are shown in tables 1 and 2 below.

Table 1: stability data for the additive of the invention.

Date	**0.5**	**1.2**	**2.5**
	ml	**ml**	**ml**
02/08/2013	0.2	0.2	0.6
09/08/2013	0.5	0.5	1
16/08/2013	0.8	0.7	1
23/08/2013	1	1	1
30/08/2013	1	1	1

Table 2: stability data for the additive of the prior art.

Date	**0.5**	**1.2**	**2.5**
	ml	**ml**	**ml**
02/08/2013	2.5	2.5	2.8
09/08/2013	2.5	2.5	3
16/08/2013	2.7	2.7	3.5
23/08/2013	3.2	3	3.5
30/08/2013	3.2	3	3.5

[0071] As may be noted from tables 1-2 above, the additive of the present invention makes it possible to obtain much lower sediment values than those obtained with the prior art additive for all three emulsions tested, in which the additives were present at concentrations of: 0.5, 1.2 and 2.5%.

Example 3: creation of micelles

[0072] Emulsions having a water concentration by weight of 15% and an amount of additive (of the invention and of the art - S1) by weight of 1.2% were prepared.

[0073] Preparation took place using the Cyntech μ-Emulsion emulsifier (high shear 7-stage rotor with asynchronous slots and hydrodynamic cavitation 3200-3600 rpm) and in the laboratory with an IKA T25 digital homogenizer (single rotor at 8000 rpm).

[0074] The samples obtained after an operating cycle of 10 minutes were analyzed. In both cases (using both Cyntech μ-Emulsion and via laboratory tests), we observed the formation of micelles having dimensions that were 70% and 74% smaller when the additive of the invention was used, compared to micelles stabilized with the commercially available additive.

Example 4: microscopic analyses

[0075] The laboratory samples of example 2 were observed under a microscope.

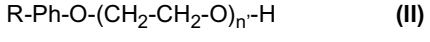
[0076] For each sample, one drop was placed on a slide and then examined using a microscope with a luminous field at 400x magnification.

[0077] The images obtained were compared with the test images available in the laboratory, so that the degree of quality of the emulsion itself could be established. The comparison between the images obtained revealed that the use of the surfactant of the present invention made it possible to obtain a more homogeneous emulsion with micelles having smaller dimensions than those of the emulsion obtained with the surfactant Empilan AMT 7, confirming the advantages of the present invention.

Claims

1. A stabilizing composition for water/light vegetable oil emulsions, said composition comprising: at least one dispersing element, at least one lubricant agent, at least one solvent and/or at least one cetane improver, and **characterized in that** it contains at least one non-ionic surfactant of formula **(I)** and/or **(II):**

(I)



(II)

wherein:

R and R' are each independently a linear or branched C_4-C_8 alkyl group, optionally substituted;
R" is selected from: -OH, -O-(CH_2-CH_2-O)$_n$-H,-COOH, and -COO-(CH_2-CH_2-O)$_n$-H;
n is an integer comprised between 2 and 5;
Ph is a bivalent phenyl group, optionally substituted;
n' is less than or equal to 40, preferably, n' is 9 or 10.

2. The composition according to claim 1, wherein R and R' are independently a linear or branched C_6-C_8 alkyl group, optionally substituted.

3. The composition according to claim 1 or 2, wherein R is equal to R'.

4. The composition according to each of the preceding claims, wherein R" is -OH, or -O-(CH_2-CH_2-O-)$_n$-H.

5. The composition according to each of the preceding claims, wherein R" is selected from -COOH and -COO-(CH_2-CH_2-O)$_n$-H.

6. The composition according to each of the preceding claims, comprising a surfactant of formula (II).

7. The composition according to each of the preceding claims, wherein the % of surfactant of formula (I) and/or (II) is comprised between 40% and 80%.

8. The composition according to each of the preceding claims, wherein said solvent is selected from: aromatic and non-aromatic solvents, naphtha, kerosene and derivatives thereof, trimethylbenzene isomers, branched paraffins, linear paraffins and alcohols having from 2 to 6 carbon atoms.

9. The composition according to each of the preceding claims, wherein said cetane improver is selected from: cetane/2-ethylhexylnitrate mixtures, cetane/aqueous ammonium nitrate mixtures, cetane/cumene peroxide mixtures and cetane/tert-butyl peroxide mixtures.

10. The composition according to each of the preceding claims, wherein said dispersing agent is a polymer molecule of polyisobutylene succinic anhydride with a molecular weight comprised between 1300 and 2400.

11. The composition according to each of the preceding claims, wherein said lubricant agent is TOFA (tall oil fatty acid) comprising unsaponifiable sterols, resin acids, fatty acids and alcohols and alkyl derivatives of hydrocarbons.

12. The composition according to each of the preceding claims, further comprising: dyes and/or co-surfactants.

13. A use of the composition as defined in each of the preceding claims for the preparation of water/light vegetable oil emulsions.

14. A process for preparing a water/light vegetable oil emulsion which comprises the steps of:

a) mixing the composition of claims 1-12 with water; and
b) emulsifying the mixture thus obtained with a light vegetable oil.

15. The process according to claim 14, wherein said light vegetable oil is selected from: soybean, rapeseed and sunflower oil and the like.

16. A water/light vegetable oil emulsion obtained with the process according to claims 14-15.

17. The water/light vegetable oil emulsion according to claim 16, comprising particles of water having dimensions comprised from 10 nm and 200 nm, preferably comprised from 10 and 100 nm.

18. The water/light vegetable oil emulsion according to claims 16-17, comprising the composition according to claims 1-12 in amounts comprised between 0.05% and 2.5%, preferably comprised between 0.1 and 1%.

19. A use of the water/light vegetable oil emulsion as defined in each of claims 16-18 as a fuel for internal combustion engines, turbines and boilers.

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EUROPEAN SEARCH REPORT

Application Number
EP 13 19 3353

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 103 305 295 A (WANG ZHAOLEI) 18 September 2013 (2013-09-18) * abstract *	1,2,5, 7-12	INV. C10L1/32
X	US 2013/118058 A1 (NGUYEN THU THI LE [US] ET AL) 16 May 2013 (2013-05-16) * claims 1-13 *	1-4,7-12	
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