R^b-O-$(AO^b)_n$-$R^{b'}$ (II)

in which

R^b is a linear or branched C_{6-32} alkyl,

AO^b is a mixture of ethylene oxide radical and propylene oxide radical,

n is a number from 1 to 100 and

$R^{b'}$ is hydrogen or C_{1-4} alkyl.

The object was also achieved by the fuel emulsion for powering a diesel engine. In another aspect, there is provided a fuel emulsion for powering a diesel engine, wherein the fuel emulsion comprises at least 10 wt% water and furthermore

a branched surfactant of the formula (I)

R^a-O-$(AO^a)_m$-$R^{a'}$ (I)

in which

R^a is a branched C_{6-32} alkyl,

AO^a is an ethylene oxide radical, propylene oxide radical, butylene oxide radical, pentylene oxide radical, styrene oxide radical or mixtures thereof,

m is a number from 1 to 100, and

$R^{a'}$ is hydrogen or C_{1-4} alkyl; and

the emulsifier package additionally comprises a propoxylated surfactant of the formula (II)

R^b-O-$(AO^b)_n$-$R^{b'}$ (II)

in which

R^b is a linear or branched C_{6-32} alkyl,

AO^b is a mixture of ethylene oxide radical and propylene oxide radical,

n is a number from 1 to 100 and

$R^{b'}$ is hydrogen or C_{1-4} alkyl

wherein the weight ratio of the water to the fuel is in the range of 1:0.1 to 1:10.

The **fuel** usually comprises hydrocarbons, such as alkanes, cycloalkanes and aromatics. The fuel may be obtained from petroleum distillation as distillate or residue. The fuels is usually a liquid fuel. Examples of fuels are gasoline, diesel or biodiesel or mixtures thereof, wherein gasoline or diesel are preferred. In particular the fuel is diesel. The gasoline may contain mainly C4 to C12 hydrocarbons of alkanes, alkenes and cycloalkanes. The diesel may contain saturated

hydrocarbons and aromatic hydrocarbons. The biodiesel typically includes lower alkyl fatty acid esters, prepared, for example, by transesterifying trigycerides with lower alcohols, e.g. methanol or ethanol.

The viscosity of the fuel can vary in a broad range, such as in the range from 1 to 10,000 mm^2/s at 40 °C (ISO 3104) or 1 to 1000 mm^2/s at 50°C (ISO 3104).

The fuel may be a **marine fuel**, such as MGO (Marine gas oil), MDO (Marine diesel oil), IFO (Intermediate fuel oil), MFO (Marine fuel oil), or HFO (Heavy fuel oil). Further examples for marine fuel are IFO 380 (an Intermediate fuel oil with a maximum viscosity of 380 centistokes (<3.5% sulphur)), IFO 180 (an Intermediate fuel oil with a maximum viscosity of 180 centistokes (<3.5% sulphur)), LS 380 (a Low-sulphur (<1.0%) intermediate fuel oil with a maximum viscosity of 380 centistokes), LS 180 (a Low-sulphur (<1.0%) intermediate fuel oil with a maximum viscosity of 180 centistokes), LSMGO (a Low-sulphur (<0.1%) Marine Gas Oil, which is often be used in European Ports and Anchorages according to EU Sulphur directive 2005/33/EC), or ULSMGO (a Ultra-Low-Sulphur Marine Gas Oil, also referred to as Ultra-Low-Sulfur Diesel (sulphur 0.0015% max). Further suitable marine fuels are according to DIN ISO 8217 of the category ISO-F- DMX, DMA, DFA, DMZ, DFZ, or DFB, or ISO-F RMA, RMB, RMD, RME, RMG, or RMK. Further suitable marine fuel is distillate marine diesel or residual marine diesel.

The viscosity of the fuel, such as the marine fuel, can vary in a broad range, such as in the range from 1 to 10,000 mm^2/s at 40 °C (ISO 3104) or 1 to 1000 mm^2/s at 50°C (ISO 3104).

Claims

1. A method for powering a diesel engine with a fuel emulsion comprising the step of preparing the fuel emulsion by emulsifying a fuel and water in the presence of an emulsifier package which comprises a branched surfactant of the formula (I)

$$R^a\text{-}O\text{-}(AO^a)_m\text{-}R^{a'} \qquad (I)$$

in which

R^a is a branched $C_{6\text{-}32}$ alkyl,

AO^a is an ethylene oxide radical, propylene oxide radical, butylene oxide radical, pentylene oxide radical, styrene oxide radical or mixtures thereof,

m is a number from 1 to 100, and

$R^{a'}$ is hydrogen or $C_{1\text{-}4}$ alkyl; and

the emulsifier package additionally comprises a propoxylated surfactant of the formula (II)

$$R^b\text{-}O\text{-}(AO^b)_n\text{-}R^{b'} \qquad (II)$$

in which

R^b is a linear or branched $C_{6\text{-}32}$ alkyl,

AO^b is a mixture of ethylene oxide radical and propylene oxide radical,

n is a number from 1 to 100 and

$R^{b'}$ is hydrogen or $C_{1\text{-}4}$ alkyl.

2. The method according to claim 1 where R^a is a branched $C_{8\text{-}14}$ alkyl.

3. The method according to any of claims 1 to 2 where R^a is a branched tridecyl.

4. The method according to any of claims 1 to 3 where AO^a is an ethylene oxide radical.

5. The method according to any of claims 1 to 4 where R^b is a linear $C_{10\text{-}22}$ alkyl

6. The method according to any of claims 1 to 5 where R^b is a linear or branched $C_{16\text{-}18}$ alkyl.

7. The method according to any of claims 1 to 6 where $R^{a'}$ and $R^{b'}$ are hydrogen.

8. The method according to any of claims 1 to 7 where the emulsifier package comprises the branched surfactant and the propoxylated surfactant in a weight ratio of 10:1 to 1:10, preferably 4:1 to 1:4.

9. The method according to any of claims 1 to 8 where the emulsifier package comprises 1 to 99 wt%, 5 to 90 wt%, 10 to 80 wt%, or 20 to 70 wt% of the branched surfactant.

10. The method according to any of claims 1 to 9 where the emulsifier package comprises 1 to 99 wt%, 5 to 90 wt%, 10 to 80 wt%, or 20 to 70 wt% of the propoxylated surfactant.

11. The method according to any of claims 1 to 10 where the emulsifier package contains up to 10 wt%, preferably up to 1 wt% of an ionic surfactant.

12. The method according to any of claims 1 to 11 where the emulsifier package comprises at least 10, 30, or 50 wt% water, the organic solvent, or a mixture of water and the organic solvent.

13. The method according to any of claims 1 to 12 where the fuel emulsion comprises the emulsifier package in an amount of 0.05 to 0.4 wt% based on the diesel.

14. The method according to any of claims 1 to 13 where the fuel emulsion comprises 40 to 80 wt% water.

15. The method according to any of claims 1 to 14 where the fuel is marine fuel.

16. A fuel emulsion for powering a diesel engine, wherein the fuel emulsion comprises at least 10 wt% water and furthermore

a branched surfactant of the formula (I)

$$R^{a}\text{-}O\text{-}(AO^{a})_{m}\text{-}R^{a'} \qquad (I)$$

in which

R^a is a branched C_{6-32} alkyl,

AO^a is an ethylene oxide radical, propylene oxide radical, butylene oxide radical, pentylene oxide radical, styrene oxide radical or mixtures thereof,

m is a number from 1 to 100, and

$R^{a'}$ is hydrogen or C_{1-4} alkyl; and

the emulsifier package additionally comprises a propoxylated surfactant of the formula (II)

$$R^b\text{-}O\text{-}(AO^b)_n\text{-}R^{b'} \qquad (II)$$

in which

R^b is a linear or branched C_{6-32} alkyl,

AO^b is a mixture of ethylene oxide radical and propylene oxide radical,

n is a number from 1 to 100 and

$R^{b'}$ is hydrogen or C_{1-4} alkyl

wherein the weight ratio of the water to the fuel is in the range of 1:0.1 to 1:10.