Emulsifier package with a branched and optionally with a propoxylated surfactant for fuel emulsion

Description

The present invention relates to 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) as defined below and optionally a propoxylated surfactant of the formula (II) as defined below. It further relates to a fuel emulsion for powering a diesel engine.

Aqueous fuel emulsions are known for powering diesel engines.

Object of the present ~~invention~~disclosure was to find an emulsifier package for fuel emulsions, which is cheap, easy to prepare, storage stable, based on commercial available emulsifiers, based only on carbon, hydrogen, nitrogen and oxygen, and allow for fast and easy emulsification even with low shear forces. The emulsifier package should result in a low foaming fuel emulsion, it should have a low cloud point, provide corrosion protection, have low foaming, improve filterability of the emulsion, and reduce precipitate when mixing the fuel with water. The emulsifier package should stabilize the fuel emulsion at high water concentrations, at various temperatures and pressures, with various types of water.

The object was achieved, in a first aspect, by 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-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 as defined above.

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).