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(54) **EMULSION-TYPE EXPLOSIVES OF THE WATER-IN-OIL TYPE**

(57) The present disclosure relates to a water-in-oil emulsion explosive composition, comprising an organic phase and an oxidizer phase at least comprising ammonium nitrate, wherein at least 50 wt.% of the normally used non-renewable oil in the organic phase is replaced with one or more renewable oils. The present disclosure relates to an explosive emulsion composition of the water-in-oil type, comprising between 80 wt.% and 95 wt.% of an oxidizer phase in view of the total weight of the emulsion composition, comprising at least 40 wt.% of ammonium nitrate (AN), and at least one or more secondary nitrate salts, comprising in particular at least 10 wt.% calcium nitrate or at least 20 wt.% calcium nitrate and/or

sodium nitrate, in view of the total weight of the oxidizer phase composition, between 5 wt.% and 20 wt.% of an organic phase in view of the total weight of the emulsion composition, the organic phase comprising between 12 wt.% and 50 wt.% of one or more emulsifiers, between 50 wt.% and 88 wt.% of a fuel composition, in view of the total weight of the organic phase composition, in which the fuel composition consists of between 0 wt.% and 50 wt.% of one or more non-renewable oils, and between 50 wt.% and 100 wt.% of one or more renewable oils, in view of the total weight of the fuel composition, the total weight% of the oils being 100.

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Description**Technical field**

5 **[0001]** The present disclosure relates to emulsion-type explosives of the water-in-oil type.

Background

10 **[0002]** Emulsion-type explosives have become increasingly more important in the civil explosives industry. The organic phase thus forms a thin film around the droplets of the oxidizer phase. Typical examples of commonly used fuels include diesel, paraffin wax, paraffin oil, slack wax and the like. In the organic phase, an emulsifier is added, which acts at the interface between the two phases to stabilize the emulsion. Due to its organic nature, the emulsifier is included in the stoichiometry of the explosion. Due to supersaturation and the immiscibility of the two phases that are mixed, an emulsion explosive is a metastable system. The emulsion is said to "break" when the organic phase and the oxidizer phase
15 separate and / or some oxidizer crystallizes out of the oxidizer phase.

[0003] Ammonium nitrate (AN) emulsions used for mining applications normally use a non-renewable mineral fuel, typically diesel, as the main fuel. However, there is a demand for a "greener" solution (more environmentally friendly) and a more sustainable solution in view of the raw materials used in the explosive emulsion.

20 **[0004]** It is already known to use vegetable oils in explosive emulsions. However, it has been found that using vegetable oil exponentially increases the viscosity and this is a problem for many applications. The primary problem however with this kind of explosive emulsions is that there is a loss of stability of the emulsion. Emulsions are by nature unstable systems. Contrary to a classical emulsion in which the organic phase containing a classical, non-renewable fuel (e.g. diesel) is mixed with an aqueous ammonium nitrate solution i.e. a monosalt oxidizer phase, mixing the same oxidizer phase with the same emulsifier, and instead of diesel, a vegetable oil which by nature has a totally different chemistry and behavior than diesel, no emulsion will be formed, and if it forms, it will lead to an unstable emulsion that will break
25 in a short time.

[0005] Patent documents often mention the use of vegetable oil as a trivial raw material to be used in explosive emulsions. However, after testing performed by the present inventors, it became clear that it is not trivial to replace large amounts of the usually used fuel, e.g. diesel or other petroleum derived fuels, i.e. non-renewable fuel, by a renewable oil, such as vegetable oil, because, after formation of the emulsion, the stability and viscosity thereof are problematic. This observation may be attributed to the different chemistry and properties of the non-renewable oils compared to renewable oils. In particular, the inventors have observed that monosalt emulsions with ammonium nitrate in the oxidizer phase and a fuel comprising vegetable oil in the organic phase does not form a stable emulsion.

30 **[0006]** There thus remains a need for a greener explosive emulsion in which the majority or the totality of the non-renewable oil is replaced by a renewable oil, which is a stable emulsion and which has a viscosity which can be adapted to be used in different applications.

Summary

40 **[0007]** The inventors have surprisingly found that stable explosive emulsions comprising renewable oils, such as vegetable oil, as fuel can be obtained by adding a suitable amount of one or more secondary salts. In particular embodiments, stable explosive emulsions with viscosities similar to explosive emulsions based on non-renewable fuel oils were also obtained with a fuel comprising both a bio-fuel, such as a hydrotreated vegetable oil (HVO), and a straight vegetable oil, when using a higher amount of one or more secondary salts in the oxidizer phase.

45 **[0008]** According to a first aspect of the present disclosure, an explosive emulsion composition of the water-in-oil type is disclosed, comprising

- between 80 wt.% and 95 wt.% of an oxidizer phase in view of the total weight of the emulsion composition, comprising
 - 50 • less than and up to 80 wt.% of ammonium nitrate (AN), and
 - (i) at least 10 wt.% of calcium nitrate (CN), and optionally one or more other secondary nitrate salts, or (ii) at least 20 wt.% of calcium nitrate (CN), sodium nitrate (SN), or a mixture thereof, in view of the total weight of the oxidizer phase composition,
- 55 - between 5 wt.% and 20 wt.% of an organic phase in view of the total weight of the emulsion composition, the organic phase comprising
 - between 12 wt.% and 50 wt.% of one or more emulsifiers,

- between 50 wt.% and 88 wt.% of a fuel composition, in view of the total weight of the organic phase composition, in which the fuel composition consists of
- between 0 wt.% and 50 wt.% of one or more non-renewable oils, and
- between 50 wt.% and 100 wt.% of one or more renewable oils,

in view of the total weight of the fuel composition, the total weight% of the non-renewable and renewable oils being 100.

[0009] By replacing at least 50 wt.% in view of the total weight of the organic phase composition of the explosive emulsion of the normally used non-renewable oil with one or more renewable oils, a "greener" explosive emulsion is obtained. However, as already mentioned above, adding a renewable oil increases the viscosity, and causes a huge loss of stability of the emulsion. Reformulating the composition of the emulsion with at least one secondary nitrate salt, in particular at least 10 wt.% or at least 15 wt.% CN, or at least 20 wt.% CN, SN or a mixture thereof, in view of the total weight of the oxidizer phase composition added to the already present ammonium nitrate in the oxidizer phase surprisingly allows to produce stable emulsions.

[0010] In a possible embodiment of an explosive composition according to the present disclosure, the explosive emulsion comprises between 85 wt.% and 95 wt.% oxidizer phase and between 5 wt.% and 15 wt.% organic phase, both in view of the total weight of the emulsion composition.

[0011] In an optional embodiment of an explosive composition according to the present disclosure, the fuel consists of between 0 wt.% and 30 wt.% of one or more non-renewable oils and between 70 wt.% and 100 wt.% of one or more renewable oils in view of the total weight of the fuel composition. The fuel more in particular consists of 100 wt.% of one or more renewable oils in view of the total weight of the fuel composition.

[0012] In an embodiment of an explosive composition according to the present disclosure, the oxidizer phase comprises between 40 wt.% and 80 wt.% of ammonium nitrate (AN) and between 10 wt.% and 50 wt.% of calcium nitrate (CN), in particular between 15 wt.% and 40 wt.% CN, and optionally one or more other secondary nitrate salts, all in view of the total weight of the oxidizer phase composition.

[0013] In an embodiment of an explosive composition according to the present disclosure, the oxidizer phase comprises between 5 wt.% and 25 wt.% of water in view of the total weight of the oxidizer phase composition.

[0014] In a possible embodiment of an explosive composition according to the present disclosure, the one or more emulsifiers are present in an amount of between 0.5 wt.% and 5.0 wt.%, more in particular between 1.0 wt.% and 2.5 wt. %, in view of the total weight of the total emulsion composition. The one or more emulsifiers are added to prevent separation of the different phases and thus to obtain a stable emulsion.

[0015] In a more particular embodiment of an explosive composition according to the present disclosure, the one or more emulsifiers are from a renewable source. In combination with 100 wt.% of one or more renewable oils in view of the total weight of the fuel composition, a fully green explosive emulsion is obtained.

[0016] The one or more renewable oils in the explosive composition according to the present disclosure may be chosen from

- a straight vegetable oil (SVO), and/ or
- a straight animal fat, and / or
- a biofuel comprising bio-diesel, a recycled vegetable oil, a recycled animal fat or a hydrotreated renewable oil;

[0017] The straight vegetable oil may be chosen from soybean oil, palm oil, rapeseed oil, maize oil, corn oil, sunflower oil, ricin oil, coconut oil, jojoba oil, jatropha oil or a mixture thereof.

[0018] In a possible embodiment of an explosive emulsion composition according to the present disclosure, the explosive emulsion composition comprises

- between 80 wt.% and 95 wt.% of an oxidizer phase, more in particular between 85 wt.% and 95 wt.% of an oxidizer phase, in view of the total weight% of the emulsion composition, wherein the oxidizer phase comprises
 - between 40 wt.% and 80 wt.% AN,
 - between 10 wt.% and 50 wt.% CN, in particular between 15 wt.% and 40 wt.% CN, and, optionally, one or more other secondary nitrate salts,
 - between 5 wt.% and 25 wt.% water,

in view of the total weight of the oxidizer phase composition; and

- between 5 wt.% and 20 wt.% of an organic phase, more in particular between 5 wt.% and 15 wt.% of an organic phase, in view of the total weight of the emulsion composition, the organic phase comprising

- between 12 wt.% and 50 wt.% of one or more emulsifiers,
- between 50 wt.% and 88 wt.% of a fuel composition,
in view of the total weight of the organic phase composition,
in which the fuel composition consists of
- between 0 wt.% and 50 wt.% of one or more non-renewable oils, particularly between 0 wt.% and 30 wt.% of one or more non-renewable oils,
- between 50 wt.% and 100 wt.% of one or more renewable oils, particularly between 70 wt.% and 100 wt.% of one or more renewable oils.
in view of the total weight of the fuel composition, the total weight% of the oils being 100.

[0019] In a further optional embodiment of an explosive emulsion composition according to the present disclosure, the explosive emulsion comprises

- between 80 wt.% and 95 wt.% of an oxidizer phase in view of the total weight of the emulsion composition, the oxidizer phase comprising
 - between 40 wt.% and 80 wt.% AN, or between 40 wt.% and 75 wt.% AN,
 - (i) between 10 wt.% and 50 wt.% CN, in particular between 15 wt.% and 40 wt.% CN, and, optionally, one or more other secondary nitrate salts, or (ii) between 20 wt.% and 50 wt.% CN, SN, or a mixture thereof, and,
 - between 5 wt.% and 25 wt.% water,
in view of the total weight of the oxidizer phase composition, and
- between 5 wt.% and 20 wt.% of an organic phase in view of the total weight of the emulsion composition, the organic phase comprising
 - between 12 wt.% and 50 wt.% of one or more emulsifiers, and
 - between 50 wt.% and 88 wt.% of a fuel composition,
in view of the total weight of the organic phase composition
in which the fuel composition consists of
 - between 0 wt.% and 100 wt.% of one or more biofuels, more specifically one or more hydrotreated renewable oils, and
 - between 0 wt.% and 100 wt.% of one or more straight vegetable oils,

in view of the total weight of the fuel composition, the total weight% of the oils being 100.

[0020] In a particular embodiment of an explosive composition according to the present disclosure, the composition has a viscosity of between 10 000 and 200 000 cP measured with a Brookfield viscometer with spindle size 7 at a frequency of 20 rpm.

Detailed description

[0021] The present disclosure relates to water-in-oil type emulsion explosives comprising an (aqueous) oxidizer (discontinuous) phase and an organic (continuous) phase. In general, the present disclosure provides stable, green explosive emulsions in which most or even all of the non-renewable oil in the organic phase as used in traditional explosive emulsions is replaced by one or more renewable oils. Advantageously, the viscosity of the explosive emulsions according to the present disclosure can be adapted to be used in different applications.

[0022] The explosive emulsion composition of the present disclosure generally comprises between 80 wt.% and 95 wt.% of an oxidizer phase and between 5 wt.% and 20 wt.% of an organic phase, both in view of the total weight of the emulsion composition. More in particular, the explosive emulsion composition comprises between 85 wt.% and 95 wt.% of an oxidizer phase and between 5 wt.% and 15 wt.% of an organic phase in view of the total weight of the emulsion composition.

[0023] The organic phase of the explosive emulsion composition according to the present disclosure generally comprises between 1 wt.% and 8 wt.%, more in particular between 2 wt.% and 5 wt.%, even more in particular between 3 wt.% and 4.5 wt.% of a fuel composition, based on the total weight of the emulsion composition. The fuel composition as envisaged herein consists of between 0 wt.% and 50 wt.% of one or more non-renewable oils (meaning a single non-

renewable oil or a mixture of different non-renewable oils), and between 50 wt.% and 100 wt.% of one or more renewable oils (meaning a single renewable oil or a mixture of different renewable oils), in view of the total weight of the fuel composition.

More in particular, the fuel composition consists of between 0 wt.% and 40 wt.%, between 0 wt.% and 30 wt.%, between 0 wt.% and between 20 wt.% or between 0 wt.% and 10 wt.% of one or more non-renewable oils and between 60 wt.% and 100 wt.%, between 70 wt.% and 100 wt.%, between 80 wt.% and 100 wt.% or between 90 wt.% and 100 wt.% (respectively, of one or more renewable oils, in view of the total weight of the fuel composition. It is understood that the total weight% of the different oils needs to be equal to 100. In particular embodiments, the non-renewable oil is diesel.

[0024] In particular embodiments, the fuel composition consists of 100 wt.% of one or more renewable oils in view of the total weight of the fuel composition. More in particular, the fuel composition consists of 0 wt.% and 100 wt.% of one or more biofuels, more in particular one or more hydrotreated renewable oils (HVO), and between 0 wt.% and 100 wt.% of one or more straight vegetable oils (SVO). Even more in particular, the fuel composition consists of between 10 wt.% and 90 wt.%, between 20 wt.% and 80 wt.%, between 30 wt.% and 70 wt.% or between 40 wt.% and 60 wt.%, of one or more biofuels, more in particular one or more hydrotreated renewable oils (HVO), and between 10 wt.% and 90 wt.%, between 20 wt.% and 80 wt.%, between 30 wt.% and 70 wt.% or between 40 wt.% and 60 wt.%, of one or more straight vegetable oils (SVO), wherein the total weight% of the one or more biofuels, in particular HVO, and the one or more SVO equals 100.

[0025] The one or more renewable oils can be chosen from a straight vegetable oil (SVO), a straight animal fat, a biofuel comprising bio-diesel, recycled vegetable oil, recycled animal fat or a hydrotreated renewable oil. Also a mixture of two of these can be applied.

[0026] A straight vegetable oil is defined as any of a group of oils that are esters of fatty acids and glycerol and are obtained from plants. In particular embodiments, the straight vegetable oil is chosen from soybean oil, palm oil, rapeseed oil, canola oil, maize oil, corn oil, sunflower oil or a mixture thereof. Less preferred SVO's which are economically less attractive, but which are also suitable, are groundnut oil, kernel oil, virgin olive oil, oil of olive residues, karite nuts butter, castor bean oil, hydrogenated castor oil, tung nuts oil, safflower seed oil, sesame seed oil, mustard seed oil, poppy seed oil, vegetable tallow, stillingia oil, kapok oil, cottonseed oil linseed oil, hempseed oil, rice bran oil, linseed oil, algae oil, peanut oil and safflower oil or a mixture thereof.

[0027] The straight animal fat can be cattle fat, buffalo fat, sheep fat, goats fat, pigs fat, poultry fat, camels fat, fat from other camelids, ghee fat or whale fat (blubber), fish oil or a mixture thereof. Animal fats tend to have more free fatty acids than vegetable oils do.

[0028] Bio-fuels are any type of transportation fuel that is derived from biomass including plant or algae material or animal waste. Bio-fuels are renewable.

[0029] Biodiesel is a form of diesel fuel derived from plants or animals and consisting of long-chain fatty acid esters. It is typically made by chemically reacting lipids such as animal fat (tallow), soybean oil or other vegetable oils with an alcohol, producing methyl, ethyl or propyl ester by a chemical process called esterification. Biodiesel has a lower boiling point and viscosity than SVO. Pure biodiesel is marketed as B100 at the gasoline stations.

[0030] Recycled vegetable oil or recycled animal fat originates from cooking such as frying or other industrial processes without intermediate processing.

[0031] Hydrotreated renewable oils, also referred to as hydrotreated vegetable oils or HVO, are paraffinic bio-based liquid oils originating from many kinds of vegetable oils, such as rapeseed, sunflower, soybean, and palm oil, as well as animal fats or rests from wood processing. As well understood by the skilled person, hydrotreated renewable or vegetable oils are obtained by subjecting fatty acid containing oils, such as vegetable oils or waste fats to a hydro-processing treatment or a hydrotreatment, wherein hydrogen is used to make paraffin and cycloalkanes out of the unsaturated compounds in the oils, which typically further undergo hydrocracking or isomerization. The term "hydrotreated vegetable oil" or HVO also refers to recycled vegetable oil, animal fats or waste fats, that have been subject to the hydrotreatment process.

[0032] The presence of a renewable oil in the organic phase causes a drop in emulsion stability. The inventors have surprisingly found that the emulsion stability is maintained when the oxidizer phase of the explosive emulsion composition of the present invention comprises next to ammonium nitrate (AN) as an oxidizer salt also a suitable amount of one or more of a secondary nitrate salt such as an alkaline earth metal nitrate salt, in particular calcium nitrate (CN), and/or an alkali metal nitrate salt, in particular sodium nitrate (SN). The oxidizer phase of the explosive emulsion composition according to the present disclosure generally comprises at least 40 wt.% of AN, particularly between 40 wt% and 80 wt% AN, in view of the total weight of the oxidizer phase composition.

[0033] In certain embodiments, the oxidizer phase comprises at least 40 wt.% of AN, particularly between 40 wt% and 80 wt.% of AN, and at least 10 wt.%, particularly at least 15 wt% of CN, and, optionally, one or more other secondary nitrate salts, with wt.% in view of the total weight of the oxidizer phase composition. More in particular, the oxidizer phase can comprise between 40 wt.% to 80 wt.% AN or between 40 wt.% and 75 wt.% AN and between 10 wt.% and 50 wt.%, particularly between 15 wt.% and 50 wt.%, more particularly between 15 wt.% and 40 wt.% of calcium nitrate, and,

optionally, one or more other secondary nitrate salts, such as sodium nitrate, with wt.% in view of the total weight of the oxidizer phase composition. Advantageously, the use of calcium nitrate as secondary nitrate salt in combination with a fuel composition comprising a vegetable oil allows to obtain stable explosive emulsion compositions with a suitable viscosity range for multiple applications.

[0034] In certain embodiments, the oxidizer phase comprises at least 40 wt.% of AN, particularly between 40 wt% and 75 wt.% of AN, and at least 20 wt.% CN, SN, or a mixture thereof, particularly between 20 wt% and 50 wt.% CN, SN, or a mixture thereof, more particularly between 20 wt% and 40 wt.% CN, SN, or a mixture thereof, even more particularly between 20 wt.% and 35 wt.% or between 25 wt.% and 35 wt.% CN, SN or a mixture thereof, with wt.% in view of the total weight of the oxidizer phase composition. When the explosive emulsion composition comprises SN as a secondary salt, the viscosity of the composition is very high. Accordingly, an explosive emulsion composition according to the present disclosure comprising SN is suitable for use in packaged emulsion (cartridge) applications.

[0035] The oxidizer phase of the explosive emulsion composition according to the present disclosure further typically comprises between 5 wt.% and 25 wt.% or between 7 wt.% and 25 wt.% of (de-ionized) water in view of the total weight of the oxidizer composition. More in particular, the amount of water present in the oxidizer phase is between 10 wt.% and 20 wt.%, such as between 12 wt.% and 17 wt.% or about 15 wt.%.

[0036] The organic phase of the explosive emulsion composition according to the present disclosure furthermore comprises an emulsifier which is added to prevent separation of the different phases and thus to obtain a stable emulsion. Particular emulsifiers include, but are not limited to PIB (polyisobutylene) derivatives such as PIBSA (polyisobutylene succinic anhydrides), sorbitan ester emulsifiers such as SMO (sorbitan monooleate) and mixtures thereof. It is however remarked that other types of emulsifiers, leading also to highly stable emulsions, could be used. In this context, the emulsifier may be chosen from the wide range of emulsifiers known in the art to be suitable for the preparation of explosive emulsion compositions. The emulsifier can be bio-sourced, i.e. produced from renewable resources. When the fuel is also completely from a renewable origin, providing an emulsifier which is bio-sourced provides a fully green solution of an explosive emulsion.

[0037] Typically, between 12 wt.% and 50 wt.% of one or more emulsifiers (meaning a single emulsifier or a mixture of different emulsifiers) in view of the total weight of the organic phase composition is present. Typical amounts of such emulsifiers in view of the total weight of the emulsion composition are between 0.5 and 5 wt.%, more in particular between 1.0 wt.% and 2.5 wt.%.

[0038] In certain embodiments, the explosive emulsion composition according to the present disclosure comprises

- between 80 wt.% and 95 wt.% of an oxidizer phase, more in particular between 85 wt.% and 95 wt.% of an oxidizer phase, in view of the total weight of the emulsion composition, the oxidizer phase comprising
 - between 40 wt.% and 80 wt.% AN, in particular between 40 wt.% or between 75 wt.% AN,
 - between 10 wt.% and 50 wt.% CN, in particular between 15 wt.% and 40 wt.% CN, and, optionally, one or more other secondary nitrate salts, and
 - between 5 wt.% and 25 wt.% water, in particular between 7 wt.% and 25 wt% water, such as between 10 wt% and 20 wt% of water.
 in view of the total weight of the oxidizer phase composition, and
- between 5 wt.% and 20 wt.% of an organic phase, more in particular between 5 wt.% and 15 wt.% of an organic phase, in view of the total weight of the emulsion composition, the organic phase comprising
 - between 12 wt.% and 50 wt.% of one or more emulsifiers, and
 - between 50 wt.% and 88 wt.% of fuel,

in view of the total weight of the organic phase composition,
in which the fuel consists of

- between 0 wt.% and 50 wt.% of one or more non-renewable oils, particularly between 0 wt. and 30 wt.% of one or more non-renewable oils such as diesel or other petroleum-derived fuels, and
- between 50 wt.% and 100 wt.% of one or more renewable oils, particularly between 70 wt.% and 100 wt.% of one or more renewable oils, particularly wherein the renewable oil is a SVO, in view of the total weight of the fuel composition, the total weight% of the oils being 100.

[0039] In certain embodiments, the explosive emulsion according to the present disclosure comprises

- between 80 wt.% and 95 wt.% of an oxidizer phase in view of the total weight of the emulsion composition, the

oxidizer phase comprising

- between 40 wt.% and 80 wt.% AN,
 - between 10 wt.% and 50 wt.% CN, in particular between 15 wt.% and 40 wt.% CN, more in particular between 15 wt.% and 30 wt.% CN, and, optionally, one or more other secondary nitrate salts; and,
 - between 5 wt.% and 25 wt.% water, particularly between 7 wt.% and 25 wt.% water, such as between 10 wt.% and 20 wt.% water,
- in view of the total weight of the oxidizer composition, and

- between 5 wt.% and 20 wt.% of an organic phase, more in particular between 5 wt.% and 15 wt.% of an organic phase, in view of the total weight of the emulsion composition, the organic phase comprising

- between 12 wt.% and 50 wt.% of one or more emulsifiers,
 - between 50 wt.% and 88 wt.% of a fuel composition,
- in view of total weight of the organic phase composition,
- in which the fuel composition consists of

◦ between 0 wt.% and 100 wt.% of one or more biofuels, more in particular one or more hydrotreated renewable oils, and

◦ between 0 wt.% and 100 wt.% of one or more SVO's,

in view of the total weight of the fuel composition.

[0040] In certain embodiments, the explosive emulsion composition according to the present disclosure comprises

- between 80 wt.% and 95 wt.% of an oxidizer phase, more in particular between 85 wt.% and 95 wt.% of an oxidizer phase, in view of the total weight of the emulsion composition, the oxidizer phase comprising

- between 40 wt.% and 75 wt.% AN, particularly between 40 wt.% and 70 wt.% AN,
- between 20 wt.% and 50 wt.% CN, SN, or a mixture thereof, in particular between 20 wt.% and 40 wt.% CN, SN, or a mixture thereof, more in particular between 20 wt.% and 40 wt.% SN or between 20 wt.% and 30 wt.% SN,
- between 5 wt.% and 25 wt.% water, in particular between 7 wt.% and 20 wt.% water,

in view of the total weight of the oxidizer phase composition, and

- between 5 wt.% and 20 wt.% of an organic phase, more in particular between 5 wt.% and 15 wt.% of an organic phase, in view of the total weight of the emulsion composition, the organic phase comprising

- between 12 wt.% and 50 wt.% of one or more emulsifiers, and
 - between 50 wt.% and 88 wt.% of fuel,
- in view of the total weight of the organic phase composition,
- in which the fuel consists of

- between 0 wt.% and 50 wt.% of one or more non-renewable oils, such as diesel or other petroleum-derived fuels, and
- between 50 wt.% and 100 wt.% of one or more renewable oils,

in view of the total weight of the fuel composition, the total weight% of the oils being 100.

[0041] In certain embodiments, the explosive emulsion composition according to the present disclosure comprises

- between 80 wt.% and 95 wt.% of an oxidizer phase, more in particular between 85 wt.% and 95 wt.% of an oxidizer phase, in view of the total weight of the emulsion composition, the oxidizer phase comprising

- between 40 wt.% and 75 wt.% AN, particularly between 40 wt.% and 70 wt.% AN,
- between 20 wt.% and 50 wt.% CN, SN, or a mixture thereof, in particular between 20 wt.% and 40 wt.% CN, SN, or a mixture thereof, more in particular between 20 wt.% and 35 wt.% or between 25 wt.% and 35 wt.% CN, SN or a mixture thereof,
- between 5 wt.% and 25 wt.% water, in particular between 7 wt.% and 25 wt.% water, such as between 10 wt.% and 20 wt.% water,

in view of the total weight of the oxidizer phase composition, and

- between 5 wt.% and 20 wt.% of an organic phase, more in particular between 5 wt.% and 15 wt.% of an organic phase, in view of the total weight of the emulsion composition, the organic phase comprising

- between 12 wt.% and 50 wt.% of one or more emulsifiers, and

- between 50 wt.% and 88 wt.% of fuel,

in view of the total weight of the organic phase composition,

in which the fuel consists of

- between 0 wt.% and 40 wt.% of one or more non-renewable oils, particularly between 0 wt. and 20 wt.% of one or more non-renewable oils such as diesel or other petroleum-derived fuels, and

- between 60 wt.% and 100 wt.% of one or more renewable oils, particularly

between 80 wt.% and 100 wt.% of one or more renewable oils in view of the total weight of the fuel composition, the total weight% of the oils being 100.

[0042] In certain embodiments, the explosive emulsion composition according to the present disclosure comprises

- between 80 wt.% and 95 wt.% of an oxidizer phase in view of the total weight of the emulsion composition, the oxidizer phase comprising

- between 40 wt.% and 80 wt.% AN,

- between 10 wt.% and 50 wt.% CN, SN, or a mixture thereof, in particular between 15 wt.% and 40 wt.% CN, SN, or a mixture thereof, such as between 20 wt.% and 40 wt.% CN, SN, or a mixture thereof, and,

- between 5 wt.% and 25 wt.% water, particularly between 7 wt.% and 25 wt% water, such as between 10 wt.% and 20 wt% water,

in view of the total weight of the oxidizer composition, and

- between 5 wt.% and 20 wt.% of an organic phase, more in particular between 5 wt.% and 15 wt.% of an organic phase, in view of the total weight of the emulsion composition, the organic phase comprising

- between 12 wt.% and 50 wt.% of one or more emulsifiers,

- between 50 wt.% and 88 wt.% of a fuel composition,

in view of total weight of the organic phase composition,

in which the fuel composition consists of • between 0 wt.% and 100 wt.% of one or more biofuels, more in particular one or more hydrotreated renewable oils, and

- between 0 wt.% and 100 wt.% of one or more SVO's,

in view of the total weight of the fuel composition.

[0043] In certain embodiments, the explosive emulsion composition according to the present disclosure comprises

- between 80 wt.% and 95 wt.% of an oxidizer phase, more in particular between 85 wt.% and 95 wt.% of an oxidizer phase, in view of the total weight of the emulsion composition, the aqueous oxidizer phase comprising

- between 40 wt.% and 75 wt.% AN,

- between 20 wt.% and 50 wt.% SN, in particular between 20 wt.% and 40 wt.% SN or between 20 wt% and 30 wt.% SN, and optionally one or more other secondary nitrate salts.

- between 5 wt.% and 25 wt.% water,

in view of the total weight of the oxidizer composition; and

- between 5 wt.% and 20 wt.% of an organic phase, more in particular between 5 wt.% and 15 wt.% of an organic phase, in view of the total weight of the emulsion composition, the organic phase comprising

- between 12 wt.% and 50 wt.% of one or more emulsifiers,

- between 50 wt.% and 88 wt.% of a fuel composition,

in view of total weight of the organic phase composition,

in which the fuel composition consists of

- between 0 wt.% and 100 wt.% of one or more biofuels, more in particular one or more hydrotreated renewable oils, and

- between 0 wt.% and 100 wt.% of one or more SVO's,

in view of the total weight of the fuel composition.

[0044] Adding a biofuel such as a hydrotreated renewable oil lowers the viscosity of the composition. By adjusting the amount of biofuel added, the viscosity of the composition can be adjusted. This is particular the case when using CN as secondary nitrate salt.

[0045] The explosive emulsion composition typically has a viscosity of between 10 000 and 200 000 cP, as measured with a Brookfield viscometer with spindle size 7 and frequency of 20 rpm, particularly as measured at a temperature between 20°C and 80°C.

Example

[0046] In Table 1 below, an overview is given of the tested samples of explosive emulsions, produced by the following procedure:

- weighing solid AN, CN and/or SN into a beaker and adding (de-ionized) water,
- heating and stirring this mixture forming a heated oxidizer solution of between 50°C to 90°C, typically between 70°C and 80°C,
- pre-mixing by gradual addition of this heated oxidizer solution to a heated mixture of oil and emulsifier while stirring at 800 rpm,
- refining at 2000 rpm for 1.5 min.

[0047] It is remarked that the steps, times and rpm used depend obviously on the equipment used, protocol developed, etc, and are not essential parts of this disclosure and can consequently be varied.

[0048] The following materials are used:

- crystalline grade ammonium nitrate (NH_4NO_3 or AN),
- calcium nitrate ($\text{Ca}(\text{NO}_3)_2$ or CN) using granules containing double salt calcium nitrate and with the overall composition: 79 wt.% $\text{Ca}(\text{NO}_3)_2$, 6 wt.% NH_4NO_3 , 15 wt.% H_2O ,
- guaranteed reagent (GR) grade for analysis sodium nitrate (NaNO_3 or SN),
- de-ionized (DI) water,
- food grade soybean oil (Coop, originating from Spain),
- food grade rapeseed oil (Rema1000, originating from Germany).
- BioLife 58 from Total, which is a type of hydrotreated vegetable (renewable) oil.

[0049] The following emulsifiers were used in the tests as shown in Table 1:

- Lubrizol 2810 (referred to in Table 1 as "Lubrizol") from Lubrizol which is a type of emulsifier in which PIBSA is the dominant component,
- Anfomul 2500 (referred to in Table 1 as "Anfomul") from Croda which is a PIB-lactone base polymeric emulsifier,
- C615 from Expanse which is a type of emulsifier in which PIBSA is the dominant component, and
- SPAN®80 (referred to in Table 1 as "SPAN") from Croda which is a type of SMO emulsifier.

[0050] The following samples as produced by the procedure as described above were tested:

- The reference which is a common emulsion with solely ammonium nitrate in the oxidizer phase, diesel as the fuel and a PIBSA emulsifier in the organic phase.
- Samples 1 to 6 which are monosalt-emulsions with ammonium nitrate in the oxidizer phase, soybean / rapeseed oil as fuel and different types of PIBSA emulsifier in the organic phase.
- Sample 7 wherein part of the vegetable oil of sample 2 is replaced by diesel as fuel in the organic phase.
- Sample 8 wherein there is an overfueling of the organic phase in view of sample 2.
- Samples 9 and 10 in which an amount of less than 5 wt.% of a secondary salt, i.e. SN or CN, in view of the total emulsion composition, is added to AN, with soybean oil as fuel and a PIBSA emulsifier in the organic phase.
- Samples 11 and 12 in which a higher amount of CN as a secondary salt, i.e. 14.1 wt.% and 27.9 wt.% versus the total weight of the emulsion composition, is added to AN in the oxidizer phase, in combination with soybean oil as the fuel and a PIBSA emulsifier in the organic phase.
- Sample 13 in which a higher amount of CN as a secondary salt, i.e. 27.9 wt.% versus the total weight of the emulsion

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composition, is added to AN in the oxidizer phase, in combination with soybean oil as the fuel and an SMO emulsifier in the organic phase.

- Sample 14 in which a higher amount of CN as a secondary salt, i.e. 36.8 wt.% versus the total weight of the emulsion composition, is added to AN in the oxidizer phase, in combination with soybean oil as the fuel and a PIBSA emulsifier in the organic phase.
- Sample 15 in which a higher amount of SN as a secondary salt, i.e. 14,5 wt.% versus the total weight of the emulsion composition, is added to AN in the oxidizer phase, in combination with soybean oil as a fuel and a PIBSA emulsifier in the organic phase.
- Sample 16 in which a higher amount of SN as a secondary salt, i.e. 14,6 wt.% versus the total weight of the emulsion composition, is added to AN in the oxidizer phase, in combination with soybean oil as a fuel and an SMO emulsifier in the organic phase.
- Sample 17 in which a higher amount of SN as a secondary salt, i.e. 27,9 wt.% versus the total weight of the emulsion composition, is added to AN in the oxidizer phase, in combination with soybean oil as a fuel and a PIBSA emulsifier in the organic phase.
- Samples 18 and 19 in which in view of sample 5, part of the rapeseed oil is replaced by a hydrotreated vegetable oil (BioLife) in the organic phase, in particular in sample 18 in an equal amount and in sample 19 the amount of straight vegetable oil is double the amount of the hydrotreated vegetable oil. A higher amount of a secondary salt, more in particular 27,9 wt.% of CN in view of the total weight of the emulsion composition, is added to AN in the oxidizer phase.

[0051] It is remarked that samples 1 to 10 are samples not according to the present disclosure, while samples 11 to 19 are samples according to the present disclosure.

Table 1: Overview of the tested samples with their composition expressed in weight% in view of the total emulsion composition

Sample	AN	CN	SN	DI water	Fuel oil		Emulsifier	
					Type	Amount	Type	Amount
Reference	80.8	0.0	0.0	14.3	Diesel	3.7	Lubrizol	1.2
Sample 1	80.8	0.0	0.0	14.3	Soybean	3.7	Anfomul	1.2
Sample 2	80.9	0.0	0.0	14.2	Soybean	3.7	Lubrizol	1.2
Sample 3	80.9	0.0	0.0	14.2	Soybean	3.7	C615	1.2
Sample 4	80.7	0.0	0.0	14.3	Rapeseed	3.8	Anfomul	1.2
Sample 5	80.9	0.0	0.0	14.3	Rapeseed	3.6	Lubrizol	1.2
Sample 6	80.8	0.0	0.0	14.3	Rapeseed	3.7	C615	1.2
Sample 7	77.1	0.0	0.0	18.1	Soybean + diesel 50/50	3.6	Lubrizol	1.2
Sample 8	75.3	0.0	0.0	17.7	Soybean	5.2	Lubrizol	1.7
Sample 9	75.9	0.0	4.8	14.2	Soybean	3.9	Lubrizol	1.3
Sample 10	75.8	4.8	0.0	14.3	Soybean	3.9	Lubrizol	1.3
Sample 11	65.6	14.1	0.0	14.2	Soybean	4.6	Lubrizol	1.5
Sample 12	51.1	27.9	0.0	13.9	Soybean	5.4	Lubrizol	1.8
Sample 13	51.1	27.9	0.0	13.9	Soybean	5.3	SPAN	1.8
Sample 14	42.5	36.8	0.0	12.8	Soybean	5.9	Lubrizol	2.0
Sample 15	64.5	0.0	14.5	13.9	Soybean	4.5	Lubrizol	1.5
Sample 16	65.3	0.0	14.6	14.0	Soybean	4.5	SPAN	1.5
Sample 17	51.1	0.0	27.9	13.9	Soybean	5.3	Lubrizol	1.8

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(continued)

Sample	AN	CN	SN	DI water	Fuel oil		Emulsifier	
					Type	Amount	Type	Amount
Sample 18	51.1	27.9	0.0	13.9	Rapeseed / BioLife 50/50	5.9	Lubrizol	1.2
Sample 19	51.1	27.9	0.0	13.9	Rapeseed / BioLife 67/33	5.9	Lubrizol	1.2

Table 2: Overview of the tested samples with their composition expressed in weight%

Sample	Oxidizer phase (wt.% in view of total emulsion composition)	Organic phase (wt.% in view of total emulsion composition)	Oxidizer phase composition (wt.% in view of oxidizer phase composition)				Organic phase composition (wt.% in view of the organic phase composition)	
			AN	CN	SN	DI water	Fuel oil	Emulsifier
Reference	95.1	4.9	85.0	0.0	0.0	15.0	75.3	24.7
Sample 1	95.1	4.9	85.0	0.0	0.0	15.0	75.3	24.7
Sample 2	95.1	4.9	85.0	0.0	0.0	15.0	75.1	24.9
Sample 3	95.1	4.9	85.0	0.0	0.0	15.0	75.2	24.8
Sample 4	95.0	5.0	85.0	0.0	0.0	15.0	75.8	24.2
Sample 5	95.2	4.8	85.0	0.0	0.0	15.0	74.9	25.1
Sample 6	95.1	4.9	85.0	0.0	0.0	15.0	75.4	24.6
Sample 7	95.2	4.8	81.0	0.0	0.0	19.0	75.0	25.0
Sample 8	93.1	6.9	81.0	0.0	0.0	19.0	75.0	25.0
Sample 9	94.8	5.2	80.0	0.0	5.0	15.0	75.0	25.0
Sample 10	94.8	5.2	79.9	5.0	0.0	15.0	75.0	25.0
Sample 11	93.9	6.1	69.9	15.0	0.0	15.1	75.5	24.5
Sample 12	92.1	7.9	46.1	40.0	0.0	13.8	75.0	25.0
Sample 13	92.9	7.1	55.0	30.0	0.0	14.9	75.0	25.0
Sample 14	92.9	7.1	55.0	30.0	0.0	15.0	75.1	24.9
Sample 15	92.9	6.0	69.5	0.0	15.6	14.9	75.0	25.0
Sample 16	94.0	6.0	69.5	0.0	15.6	14.9	75.0	25.0
Sample 17	92.9	7.1	55.0	0.0	30.0	14.9	75.0	25.0
Sample 18	92.9	7.1	55.0	30.0	0.0	15.0	83.1	16.9
Sample 19	92.9	7.1	55.0	30.0	0.0	15.0	83.1	16.9

Stability

[0052] The shear stress stability of the different tested samples as mentioned in Table 1 as mentioned in Table 3 below was measured by the following method:

- cooling the explosive emulsion to room temperature (20°C),

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- mixing the cooled explosive emulsion in a kitchen mixer and stressing it for 30 minutes,
- revealing the number and the size of the formed crystals by means of a polarized light microscope analysis,
- multiplying the crystal size and the crystal number resulting in a stability score between 0 and 20, where 0 corresponds to a separated emulsion and 20 to a perfect emulsion with nearly no crystals. In industry, emulsions having a stability score between 18 and 20 are considered stable.

Viscosity

[0053] The viscosity as mentioned in Table 3 below of the different tested samples as mentioned in Table 1 was measured using the following measurement method: a spindle of a Brookfield viscometer with spindle size 7 at a frequency of 20 rpm is rotated for 30s (this time being an optional choice in the viscometer settings). The viscosity of the following emulsions is measured as:

- freshly made emulsion (temperature may typically vary from between 50°C and 85°C depending on the salt concentration - higher salt content requires higher temperature for dissolution)
- at a temperature of 70°C;
- cooled emulsion (1 hour at 5°C), which gives emulsion temperatures of ~ 30°C.

The viscosity is measured in mPa*s = cP and a typical value for a commercial emulsion is between 35 000 and 50 000 cP. Based on our experience and equipment, the measured viscosity is well reproducible and has an accuracy of ± 2000 cP.

Table 3: The viscosity of the samples which are freshly made, at a temperature of 70°C and at a temperature of 30°C, and the stability of the tested samples as listed in Table 1

Sample	Viscosity (mPa*s)			Stability (LSST)
	Fresh	70°C	30°C	
Reference	41800	51600	65600	20
Sample 1	130000	113000	123000	Crystallized
Sample 2	144000	136000	175000	Crystallized
Sample3	131000	157000	186000	Crystallized
Sample 4	118000	111000	131000	Crystallized
Sample 5	133000	152000	174000	Crystallized
Sample 6	107000	119000	146000	Crystallized
Sample 7	102000	110000	117000	Crystallized
Sample 8	125000	116000	152000	Crystallized
Sample 9	144000	>200000	>>200000	Crystallized
Sample 10	Did not emulsify			
Sample 11	83000	93400	115000	19.3
Sample 12	68400	70000	109000	20.0
Sample 13	72400	50600	94800	19.9
Sample 14	83400	74000	104000	20.0
Sample 15	200000	185000	>>200000	19.4
Sample 16	60400	140000	175000	19.8
Sample 17	133000	163000	185000	19.4
Sample 18	35600	30600	38400	20.0
Sample 19	48400	46200	54200	20.0

[0054] Out of results as shown in Table 3, it can be concluded that:

- Monosalt emulsions with ammonium nitrate in the oxidizer phase and vegetable oil as a fuel in the organic phase form an emulsion which is however not stable and crystallizes during transport, regardless of the type of vegetable oil and emulsifier used.
- When part of the vegetable oil is replaced by diesel to try to improve the stability of the monosalt emulsion, the desired effect is not accomplished.
- Overfueling of the organic phase to try to increase stability, which is a common industrial practice, also does not have the desired effect.
- Addition of some amount of a secondary salt (less than 5 wt.% versus the total weight of the emulsion composition) in order to increase stability does not have the desired effect.
- Addition of a higher amount of a secondary salt (for instance at least 14 wt.% in view of the total weight of the emulsion composition or 15 wt.% in view of the weight of the oxidizer phase composition) surprisingly stabilizes the emulsion. It is however remarked that, when adding SN as a secondary salt, the viscosity becomes very high. In e.g. packaged emulsion (cartridge) applications, a high viscosity is however acceptable.
- By replacing part of the vegetable oil in the organic phase by a hydrotreated vegetable oil (HVO) and adding a higher amount of a secondary salt, particularly CN, the viscosity is reduced and is close to the reference sample.
- The type of emulsifier (SMO or PIBSA) has no significant impact on the viscosity and the shear stress stability of the explosive emulsion.

Claims

1. An explosive emulsion composition of the water-in-oil type, comprising

- between 80 wt.% and 95 wt.% of an oxidizer phase in view of the total weight of the emulsion composition, comprising

• at least 40 wt.% of ammonium nitrate (AN), and

(i) at least 10 wt.% of calcium nitrate (CN), and optionally one or more other secondary nitrate salts, or
(ii) at least 20 wt.% of calcium nitrate, sodium nitrate (SN), or a mixture thereof.
in view of the total weight of the oxidizer phase composition, and

- between 5 wt.% and 20 wt.% of an organic phase in view of the total weight of the emulsion composition, the organic phase comprising

- between 12 wt.% and 50 wt.% of one or more emulsifiers,
- between 50 wt.% and 88 wt.% of a fuel composition,
in view of the total weight of the organic phase composition,
in which the fuel composition consists of
- between 0 wt.% and 50 wt.% of one or more non-renewable oils, and
- between 50 wt.% and 100 wt.% of one or more renewable oils,

in view of the total weight of the fuel composition, the total weight% of the non-renewable and renewable oils being 100.

2. Explosive emulsion composition according to claim 1, wherein the explosive emulsion composition comprises between 85 wt.% and 95 wt.% oxidizer phase and between 5 wt.% and 15 wt.% organic phase, both in view of the total weight of the emulsion composition.

3. Explosive composition according to claim 1 or 2, wherein the fuel composition consists of between 0 wt.% and 30 wt.% of one or more non-renewable oils and between 70 wt.% and 100 wt.% of one or more renewable oils, more in particular consists of 100 wt.% of one or more renewable oils, all in view of the total weight of the fuel composition.

4. Explosive composition according to any one of claims 1 to 3, wherein the oxidizer phase comprises between 40 wt.% and 80 wt.% of ammonium nitrate (AN) and between 10 wt.% and 50 wt.% of calcium nitrate (CN), and optionally

one or more other secondary nitrate salts, more in particular between 15 wt.% and 40 wt.% of CN, all in view of the total weight of the oxidizer phase composition.

5. An explosive composition according to any one of claims 1 to 4, wherein the oxidizer phase comprises between 5 wt.% and 25 wt.% of water in view of the total weight of the oxidizer phase composition.

6. An explosive composition according to any one of claims 1 to 5, wherein the one or more emulsifiers are present in an amount of between 0.5 wt.% and 5.0 wt.%, more in particular between 1.0 wt.% and 2.5 wt. %, in view of the total weight of the emulsion composition.

7. An explosive composition according to any one of claims 1 to 6, wherein one or more emulsifiers are from a renewable source.

8. An explosive composition according to any one of claims 1 to 7, wherein the one or more renewable oils are chosen from

- a straight vegetable oil (SVO), and/or
- a straight animal fat, and/or
- a biofuel comprising bio-diesel, recycled vegetable oil, recycled animal fat or a hydrotreated renewable oil.

9. Explosive composition according to claim 8, wherein the SVO is chosen from soybean oil, palm oil, rapeseed oil, canola oil, maize oil, corn oil, sunflower oil, ricin oil, coconut oil, jojoba oil, jatropha oil or a mixture thereof.

10. Explosive emulsion composition according to any one of claims 1 to 9, wherein the explosive emulsion comprises

- between 80 wt.% and 95 wt.% of an oxidizer phase, more in particular between 85 wt.% and 95 wt.% of an oxidizer phase, in view of the total weight of the emulsion composition, the aqueous oxidizer phase comprising

- between 40 wt.% and 80 wt.% AN,
 - between 10 wt.% and 50 wt.% CN, in particular between 15 wt.% and 40 wt.% CN, and, optionally, one or more other secondary nitrate salts, and
 - between 5 wt.% and 25 wt.% water,
- in view of the total weight of the oxidizer composition; and

- between 5 wt.% and 20 wt.% of an organic phase, more in particular between 5 wt.% and 15 wt.% of an organic phase, in view of the total weight of the emulsion composition, the organic phase comprising

- between 12 wt.% and 50 wt.% of one or more emulsifiers,
 - between 50 wt.% and 88 wt.% of a fuel composition,
- in view of total weight of the organic phase composition, in which the fuel composition consists of
- between 0 wt.% and 50 wt.% of one or more non-renewable oils, particularly between 0 wt. and 30 wt.% of one or more non-renewable oils, and
 - between 50 wt.% and 100 wt.% of one or more renewable oils, particularly between 70 wt.% and 100 wt.% of one or more renewable oils,

in view of the total weight of the fuel composition.

11. Explosive composition according to claim 10, wherein the explosive emulsion comprises

- between 80 wt.% and 95 wt.% of an oxidizer phase in view of the total weight of the emulsion composition, the oxidizer phase comprising

- between 40 wt.% and 80 wt.% AN,
 - between 10 wt.% and 50 wt.% CN, in particular between 15 wt.% and 40 wt.% CN, and, optionally, one or more other secondary nitrate salts; and,
 - between 5 wt.% and 25 wt.% water,
- in view of the total weight of the oxidizer composition, and

- between 5 wt.% and 20 wt.% of an organic phase, more in particular between 5 wt.% and 15 wt.% of an organic phase, in view of the total weight of the emulsion composition, the organic phase comprising

- between 12 wt.% and 50 wt.% of one or more emulsifiers,
- between 50 wt.% and 88 wt.% of a fuel composition, in view of total weight of the organic phase composition, in which the fuel composition consists of
- between 0 wt.% and 100 wt.% of one or more biofuels, more in particular one or more hydrotreated renewable oils, and
- between 0 wt.% and 100 wt.% of one or more SVO's,

in view of the total weight of the fuel composition.

12. Explosive composition according to any one of claims 1 to 9, wherein the explosive emulsion comprises

- between 80 wt.% and 95 wt.% of an oxidizer phase in view of the total weight of the emulsion composition, the oxidizer phase comprising

- between 40 wt.% and 75 wt.% AN,
 - between 20 wt.% and 50 wt.% CN and/or SN, in particular between 20 wt.% and 40 wt.% CN and/or SN, and
 - between 5 wt.% and 25 wt.% water,
- in view of the total weight of the oxidizer composition, and

- between 5 wt.% and 20 wt.% of an organic phase, more in particular between 5 wt.% and 15 wt.% of an organic phase, in view of the total weight of the emulsion composition, the organic phase comprising

- between 12 wt.% and 50 wt.% of one or more emulsifiers,
- between 50 wt.% and 88 wt.% of a fuel composition, in view of total weight of the organic phase composition, in which the fuel composition consists of
- between 0 wt.% and 100 wt.% of one or more biofuels, more in particular one or more hydrotreated renewable oils, and
- between 0 wt.% and 100 wt.% of one or more SVO's,

in view of the total weight of the fuel composition.

13. Explosive emulsion composition according to any one of claims 1 to 9, wherein the explosive emulsion comprises

- between 80 wt.% and 95 wt.% of an oxidizer phase, more in particular between 85 wt.% and 95 wt.% of an oxidizer phase, in view of the total weight of the emulsion composition, the aqueous oxidizer phase comprising

- between 40 wt.% and 75 wt.% AN,
 - between 20 wt.% and 50 wt.% SN, in particular between 20 wt.% and 40 wt.% SN, and optionally one or more other secondary nitrate salts.
 - between 5 wt.% and 25 wt.% water,
- in view of the total weight of the oxidizer composition; and

- between 5 wt.% and 20 wt.% of an organic phase, more in particular between 5 wt.% and 15 wt.% of an organic phase, in view of the total weight of the emulsion composition, the organic phase comprising

- between 12 wt.% and 50 wt.% of one or more emulsifiers,
- between 50 wt.% and 88 wt.% of a fuel composition, in view of total weight of the organic phase composition, in which the fuel composition consists of
- between 0 wt.% and 100 wt.% of one or more biofuels, more in particular one or more hydrotreated renewable oils, and
- between 0 wt.% and 100 wt.% of one or more SVO's,

in view of the total weight of the fuel composition.

- 14.** Explosive composition according to any one of the preceding claims, wherein the composition has a viscosity of between 10 000 and 200 000 cP measured with a Brookfield viscometer with spindle size 7 at a frequency of 20 rpm.

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