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(54) **HYDROGENATED OIL FUEL**

(57) A solid firelighter is provided, which comprises one or more hydrogenated vegetable oils. Moreover, a method of producing said a firelighter is provided, as well as compositions for use as firelighters and methods of using such firelighters.

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Description

Field of invention

[0001] The present invention relates to firelighters and lamp fuels, which comprises hydrogenated vegetable oil and the use thereof.

Background of invention

[0002] The present invention relates to firelighters and lamp fuels. Firelighters are small solid fuel tablets sold as consumer products and designed to replace kindling in starting a fire. Firelighters are typically used to start wood or coal fire in homes. However, they can also be used alone as fuel in specially-designed portable stoves.

[0003] Lighting solid fuel fires constructed of coal, charcoal, peat and the like presents a number of practical difficulties since most solid fuels are slow burning and difficult to light but release appreciable amounts of energy when lit. The ignition of coal fires can be assisted by the use of commercially available firelighters. These are used by placing the firelighter block in the hearth where the fire is to be made, lighting the block and then placing coal on top of the firelighter block in an attempt to light the coal from the block.

[0004] Some firelighters consist of a solid generally cubic block containing a petroleum-based fuel, typically paraffin/kerosene. In a typical firelighter, urea-formaldehyde is utilized as a curable resin, which is combined with the petroleum-based fuel. Petroleum-based firelighters typically have a bad odour before burning, and a sooty flame. Moreover, kerosene/paraffin fuels suffer from the major drawback that they are highly toxic, especially upon ingestion. Even the slightest quantities of these dangerous fuels are sufficient to give heavy lung damages, for example chemical pneumonia, which in worst cases may be mortal. Firelighters are given the UN number 2623 for dangerous goods and hazardous substances.

[0005] In order to avoid the use of petroleum-based fuel in firelighters, a number of alternative firelighters have also been presented. Such firelighters may include saw dust, oil compositions, such as biodiesel. However, these firelighters can be difficult to light, due to relatively high flash points.

[0006] Biodiesel produced from vegetable oils are made by an esterification process, which produces so-called fatty acid methyl esters, FAME or biodiesel. Other acronyms are also used such as rape seed methyl ester RME, soybean methyl ester SME or palm oil methyl ester PME. However, life cycle greenhouse gas emissions of hydrogenated vegetable oil are lower than those of FAME if the both are made from the same feedstock; cf. Renewable Energy Directive 2009/28/EC.

[0007] Conventional lamp fuel compositions are based on kerosene/paraffin or petrol. These fuel compositions also suffer from the major drawback that they are highly toxic, especially upon ingestion. Even the slightest quantities of these dangerous fuels are sufficient to give heavy lung damages.

[0008] The present disclosure provides a firelighter and lamp fuel, where the fuel has been replaced with a hydrogenated vegetable oil. Such firelighters and lamp fuels are easy to light, are non-toxic, have no significant odour, and provide a stable, long-lasting flame.

Summary of invention

[0009] Solid firelighters and lamp fuels comprising hydrogenated vegetable oil as combustible fuel are provided herein, as well as methods of producing and using such firelighters and lamp fuels. The vegetable oil may be obtained from any available source as described herein below.

[0010] In one aspect, the present invention relates to a firelighter or lamp fuel comprising one or more hydrogenated vegetable oils or mixtures thereof.

[0011] In another aspect, a method is provided of producing a firelighter, said method comprising

a) providing one or more vegetable oils or mixtures thereof, a hydrogen source and catalyst
b) combining said one or more vegetable oils or mixtures thereof, hydrogen source and catalyst
c) incubating said combined one or more vegetable oils or mixtures thereof, hydrogen source and catalyst for a sufficient amount of time to produce a hydrogenated vegetable oil
d) obtaining said hydrogenated one or more vegetable oils or mixtures thereof and providing a solidifying treatment.

[0012] In a third aspect, the invention relates to a use of one or more hydrogenated vegetable oils as a firelighter or a lamp fuel.

[0013] In a fourth aspect, a method is provided of lighting a burnable material, said method comprising

a) providing a burnable material
b) providing a firelighter comprising one or more hydrogenated vegetable oils
c) placing said firelighter in contact or in the vicinity of said burnable material
d) lighting said firelighter, and
e) allowing said firelighter to burn for a sufficient amount of time to light said burnable material.

[0014] In a fifth aspect, the invention provides a liquid candle comprising a lamp fuel comprising one or more hydrogenated vegetable oils.

Detailed description of the invention

[0015] Firelighters are generally small blocks comprising a combustible fuel confined in a solid matrix, where the fuel can be ignited and burn for a sufficient amount of time to light burnable materials with slightly higher flash points. The present invention provides a firelighter comprising one or more hydrogenated vegetable oils. More specifically, the firelighter comprises at least 20% by weight of one or more hydrogenated vegetable oils. In one embodiment, the firelighter comprises 20-95% by weight of one or more hydrogenated vegetable oils.

[0016] In another embodiment, the invention provides a lamp fuel comprising one or more hydrogenated vegetable oils.

[0017] Treatment of vegetable oils by hydrogenation can transforms liquid oils into more viscous fluids or even solid waxes that can be used as firelighters or lamp fuels. Firelighters and lamp fuels of the present invention produce very little or none noxious aromas and unwanted gasses.

[0018] Normally, the major processes for the hydrogenation of oils involve a number of steps to "clean up" the final product, and these include steps of degumming, deodorizing and bleaching of the processed oil. Regardless of any initial procedures to prepare the oil for dehydrogenation, the oil can be subject to hydrogenation by providing a hydrogen source and a suitable catalyst.

[0019] Hydrogenated vegetable oil is typically a mixture of straight chain and branched paraffins, which are the simplest type of hydrocarbon molecules in terms of clean and complete combustion. Typical carbon numbers are C_{10}- C_{18}. Paraffins exist also in fossil diesel fuels which also contain significant amounts of aromatics and naphthenics. Aromatics are not favourable for clean combustion. Hydrogenated vegetable oil is practically free of aromatics and its composition is quite similar to Gas to Liquid fuel (GtL) and Biomass to Liquid (BtL) diesel fuels made by Fischer Tropsch synthesis from natural gas and gasified biomass.

[0020] Hydrogenated vegetable oil is also known as renewable diesel or HDRD (Hydrogenation Derived Renewable Diesel) especially in USA and HBD (Hydrogenerated Biodiesel) in Far East.

Vegetable oil

[0021] The vegetable oil utilized in the firelighters, lamp fuels and methods and uses provided herein can be any available vegetable oil. Practically, the oil may be provided as a waste vegetable oil or a pure vegetable oil. The use of waste vegetable oil may be economically beneficial when producing large amounts of refined oil. Enormous amounts of waste vegetable oil are produced annually, mainly from industrial deep fryers in potato processing plants, snack food factories and fast food restaurants. This waste product may be recycled for use in production of compositions of the present invention. Pure vegetable oil (pure plant oil (PPO) or Straight Vegetable Oil (SVO)), in contrast to waste vegetable oil, is not a by-product of other industries, and thus its prospects for use as fuel are not limited by the capacities of other industries. Important considerations when selecting a suitable vegetable oil for use in the present invention includes its suitability as a fuel, based on flash point, energy content, viscosity, combustion products and other factors, as well as the cost, based in part on yield, effort required to grow and harvest, and post-harvest processing cost.

[0022] The most common commercially used oil crops are particularly preferred. In a preferred embodiment, the vegetable oil is selected from the group consisting of coconut, corn, cottonseed, olive, palm, peanut, rape, rapeseed, safflower, sesame, soybean, jatropha and sunflower oils. In a preferred embodiment, the vegetable oil is rape oil, rapeseed oil, soybean oil, jatropha or sunflower oil. In another embodiment, the vegetable oil is a nut oil, such as oil extracted from almond, cashew, hazelnut, macadamia, mongongo, pecan, pine, pistachio, and walnut. In yet another embodiment, the vegetable oil of the present invention is extracted from Castor, Coconut, Corn, Cottonseed, False, Hemp, Mustard, Palm, Peanut, Radish, Rapeseed, Ramtil, Rice, Safflower, Salicornia, Soybean, Sunflower, and/or Tung. However, in general, any commercially available oil can be used.

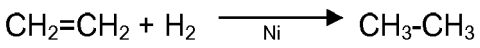
[0023] In another embodiment, the vegetable oil is selected from the group consisting of soybean, rape seed, sunflower, safflower, palm, palm kernel, coconut, cottonseed, wheat germ, olive, corn, hemp, crambe, peanut, canola, jatropha plant, castor bean, coriander, hazelnut, hempseed, mango kernel, meadowfoam, palm olein, palm stearin, palm kernel olein, palm kernel stearin, peanut, rice bran, sasanqua, sunflower seed, tsubaki and combinations thereof.

[0024] In yet another embodiment, the vegetable oil is selected from the group consisting of coconut, corn, cottonseed,

olive, palm, peanut, rape, rapeseed, canola, safflower, sesame, soybean, jatropha and/or sunflower oils; for example, the vegetable oil is selected from the group consisting of sunflower oil, olive oil, rape oil soy bean oil and jatropha oil. In a preferred embodiment, the vegetable oil is a rapeseed oil, and in an even more preferred embodiment, the vegetable oil is palm tree oil or palm kernel oil.

Hydrogenation of vegetable oil

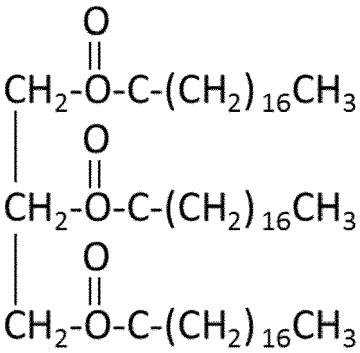
[0025] Hydrogenation refers to the reaction of the carbon-carbon double bond in alkenes with hydrogen in the presence of a metal catalyst. It includes the manufacture of margarine and waxes from animal or vegetable fats and oils. In a simple illustrative reaction, ethene reacts with hydrogen in the presence of a finely divided nickel catalyst at a temperature of about 150°C, and ethane is produced:



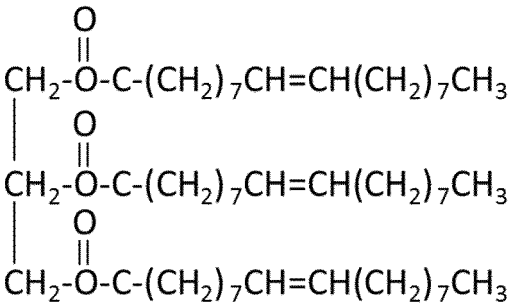
[0026] The melting point of a vegetable oil is largely determined by the presence of carbon-carbon double bonds in the molecule. The higher the number of carbon-carbon double bonds, the lower the melting point. Thus, hydrogenation of a vegetable oil inherently increases the melting point of the oil composition.

[0027] If there are no carbon=carbon double bonds, the molecule is said to be saturated.

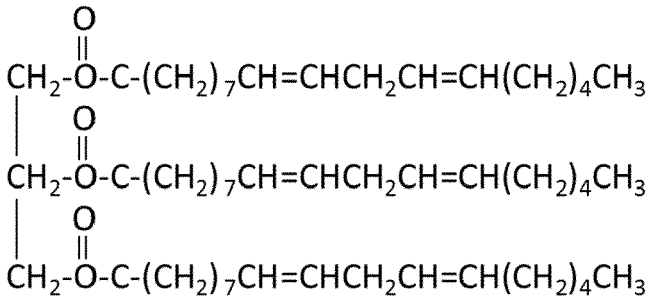
[0028] Vegetable oil consists mainly of triglyceride molecules, which are an ester compounds derived from glycerol and three fatty acids. A saturated triglyceride could have the structure:



[0029] If there is only one carbon-carbon double bond in the carboxylic acid sidechains, it is called a mono-unsaturated fat (or mono-unsaturated oil, because it is likely to be a liquid at room temperature). An example of a mono-unsaturated oil could be:



[0030] This triglyceride comprises three mono-unsaturated carboxylic acid sidechains. If there are two or more carbon-carbon double bonds a carboxylic acid sidechain, then it is said to be polyunsaturated. An example of a triglyceride having polyunsaturated carboxylic acid sidechains could be:



[0031] In this triglyceride compound, each of the carboxylic sidechains has more than one double bond. However, each triglyceride compound may comprise different sidechains, and therefore could have one sidechain, which in saturated and other sidechains which have one or more double bonds.

[0032] Oils can contain more or less of unsaturated triglycerides. Vegetable oils often contain high proportions of polyunsaturated and mono-unsaturated fats (oils), and as a result are liquids at room temperature. Hydrogenation of the vegetable oil raises the melting point of the oil, and may also harden the oil composition.

[0033] The extent of hydrogenation can be controlled by the conditions used for the hydrogenation process. The efficiency of the process is dependent on reaction temperature, the reaction time, the amount of hydrogen passed through the oil, the choice of catalyst, the pressure in the reaction chamber as well as other reaction conditions. Thus, hydrogenation can be controlled in order to ensure that a certain amount, but not necessarily all, of the carbon-carbon double bonds are hydrogenated. If only a proportion of the carbon=carbon double bonds are hydrolysed, the oil is a partially hydrogenated oil.

[0034] The extent of hydrogenation can be measured by the iodine value of the composition.

[0035] The iodine value is defined by the mass of iodine in grams that is consumed by 100 grams of the vegetable oil. Iodine numbers can be used to determine the amount of unsaturation in carboxylic acids because the double bonds react with iodine. The higher the iodine number, the more C=C bonds are present in the oil. The iodine value of a firelighter or lamp fuel as provided herein is preferably below 50, such as more preferred below 25. Most preferred, the iodine value is below 20 or even below 15.

[0036] Hydrogenated vegetable oils differ in two major ways from other oils which are equally saturated. During hydrogenation, it is easier for hydrogen to come into contact with the carboxylic acid sidechains on the end of the triglyceride, and less easy for them to come into contact with the center carboxylic acid. The other difference is that trans-fatty acids are formed in the hydrogenation reactor, and may amount to as much as 40 percent by weight of a partially hydrogenated oil.

[0037] Generally, unsaturated triglycerides contained in vegetable oils are refractory towards hydrogenation, and typically require high temperature, high pressure, prolonged hydrogenation time or combinations thereof in order to obtain satisfactory hydrogenation. Conventionally, unsaturated triglycerides are hydrogenated with hydrogen gas in the presence of at least 0.2 to 0.5% nickel hydrogenation catalyst, and sometimes a higher quantity of catalyst, at temperatures at or above 150°C, and under pressures of from 60 psig to 100 psig or greater. Reaction times of at least 1 to 8 hours or longer are generally required, depending upon the degree of hydrogenation desired.

[0038] Under these conditions, the carbon atoms of the oil to break double-bonds with other carbons, each carbon forming a new single-bond with a hydrogen atom. Adding these hydrogen atoms to the oil increases its viscosity, raises the smoke point, and makes the oil more stable.

Firelighter

[0039] The firelighter of the present invention comprises one or more hydrogenated vegetable oils. In one embodiment, the firelighter comprises at least 20% by weight of one or more hydrogenated vegetable oils. In another embodiment, the firelighter comprises at least 30% by weight of one or more hydrogenated vegetable oils, such as at least 40% by weight, such as at least 50% by weight, such as at least 60% by weight, such as at least 70% by weight, such as at least 80% by weight, such as at least 90% by weight, such as at least 95% by weight, such as at least 98% by weight of one or more hydrogenated vegetable oils. In one embodiment, the firelighter comprises 100% by weight of one or more hydrogenated vegetable oils.

[0040] In another embodiment, the firelighter comprises 20-95% by weight of one or more hydrogenated vegetable oils, for example 30-95% by weight, such as 40-95% by weight, for example 50-95% by weight, for example 60-95% by weight, such as 70-95% by weight, for example 80-95% by weight of one or more hydrogenated vegetable oils.

[0041] In one embodiment, the firelighter comprises 30-90% by weight, such as 30-85% by weight, for example 30-80% by weight of one or more hydrogenated vegetable oils.

[0042] The firelighter is preferably a solid block, such as a a cubic tablet. For example, the firelighter measures 0.5-3 cm x 1-5 cm x 1-10 cm, for example about 1.5 x 3 x 4 cm.

[0043] The firelighter is preferably solid at room temperature, having a melting temperature preferably above 30°C, and preferably above 35°C, such as above 40°C, such as 45°C, such as above 50°C, such as 55°C, such as above 60°C, such as 65°C, such as above 70°C, such as 75°C, such as above 80°C, such as 85°C.

[0044] The specific carboxylic acids present in the firelighter depend of the choice of vegetable oil. In a preferred embodiment, the firelighter preferably comprises C_6-C_{18} carboxylic acids, in particular C_{16} or C_{18}, such as $C_{16:0}$, $C_{18:0}$, $C_{18:1}$, $C_{18:2}$, $C_{18:3}$ or $C_{18:4}$.

[0045] The firelighter may in addition to hydrogenated vegetable oil comprise woodfuel byproducts such as sawdust and/or chips.

[0046] The firelighter may also comprise charcoal, which helps providing a long-lasting fuel source.

[0047] The firelighter of the present invention may further comprise one or more additional components. Thus, any component, which is used in the art for preparing firelighters, may be incorporated in the firelighter of the present invention, and in the methods and uses provided herein for the manufacture of a firelighter.

[0048] The firelighter of the present invention may comprise a range of additional components. For example, the compositions can optionally include one or more additional components, such as lubricants, emulsifiers, wetting agents, densifiers, fluid-loss additives, corrosion inhibitors, oxidation inhibitors, friction modifiers, demulsifers, anti-wear agents, anti- foaming agents, detergents, rust inhibitors and the like. The firelighter may also comprise solidifying agents and/or curable agents. Furthermore, other hydrocarbonaceous fuels may be added to the firelighter, provided that the final blend has the appropriate physical properties, such as flash point, viscosity, curability and toxicity properties to allow for a suitable firelighter.

[0049] The firelighter may for example comprise at least one emulsifying agent. An emulsifier or an emulgent is a substance which stabilizes an emulsion by increasing its kinetic stability. The emulsifier aids in mixing the components of the firelighter, and is used to provide firelighters affording an even distribution of the dispersed fuel phase throughout the firelighter.

[0050] The firelighter or the present invention, thus, in one embodiment, in addition one or more hydrogenated vegetable oils, further comprise one or more solids, such as any one of those mentioned above.

[0051] In addition to combustible components, one or more inorganic materials may be added to the firelighter, to reduce cost, modify weight or performance and/or to assist further in cooling of the composition by being chilled, e.g. felspar, chalk, limestone, sand, talc, fuller's earth, bentonite, Fly ash, fillite, perlite, vermiculite, mica, calcium carbonate, or sodium bicarbonate.

Curable resin

[0052] The firelighter of the present invention is a solid firelighter block comprising a hydrogenated vegetable oil fuel. In a preferred embodiment, the firelighter is structured in a solid matrix. The solid matrix is preferably prepared from a curable resin. Thus, in a broad aspect, the present invention relates to a firelighter comprising one or more hydrogenated vegetable oils, and a curable resin. Preferably, the hydrogenated vegetable oil is selected from those described above.

[0053] A curable resin is a resin, which can be cured. In the present context, the term "curing" refers to the process of changing the physical properties of a resin or adhesive by chemical reaction, which may be in the form of condensation, polymerization, or vulcanization, Specifically, "curing" refers to the toughening or hardening of a substance, such as a polymer material, for example by cross-linking of polymer chains. Curing is accomplished by the action of a curing agent, which may be chemical additives/catalysts, ultraviolet radiation, electron beam, heat, and/or pressure, alone or in combination. In rubber, the curing process is also called vulcanization.

[0054] The firelighters of the present invention may comprise any suitable curable resin. A suitable curable resin serves the purpose of being able to confine hydrogenated vegetable oils of the present invention is a matrix, which can be used as a solid firelighter. In the production of certain firelighters, an oil in water emulsion is utilized, which is cured by addition of a catalyst. Other firelighters utilize a soap in oil emulsion or gel, where the soap is made by a reaction of caustic soda and stearic acid, where the curing is obtained by heating of the emulsion or gel.

[0055] Urea/formaldehyde type resin is widely used as the curable resin in the production of firelighters and the curing agent for the urea/formaldehyde resin is generally a mineral acid, conveniently a hydrochloric, phosphoric or a sulphuric acid. Thus, in preferred embodiment of the present invention, the curable resin is urea/formaldehyde; and thus, the provided firelighter preferably comprises a urea/formaldehyde resin, and one or more hydrogenated vegetable oils or mixtures thereof, and a urea/formaldehyde resin.

[0056] The urea-formaldehyde resin may, however, also be replaced by other suitable resins, including melamine formaldehyde resin and/or polyurethane.

[0057] The amount of curable resin comprised in the firelighter of the present invention depends on the choice of resin. The person skilled in the art will appreciate in which concentrations a curable resin should be used in order to fulfill its

function of establishing the matrix of the solid firelighter. Therefore, the firelighter of the present invention comprise for example between 0.1 and 90% by weight of curable resin, for example between 0.1 and 10, for example between 10 and 20, such as between 20 and 30, for example between 30 and 40, for example between 40 and 50, between 50 and 60, for example between 60 and 70 %, for example between 80 and 90 by weight of a curable resin, such as urea-formaldehyde. More preferred, the firelighter of the present invention comprise between 0.1 and 20 % by weight, such as between 5 and 15%, such as between 5 and 6%, for example between 6 and 7%, for example between 7 and 8 %, such as between 8 and 9%, for example between 9 and 10%, for example between 10 and 11 %, such as between 11 and 12%, for example between 12 and 13%, for example between 13 and 14 %, such as between 14 and 15% by weight of a curable resin, such as urea-formaldehyde.

Method of producing firelighter

[0058] In one aspect of the present invention a method is provided for producing a firelighter comprising one or more hydrogenated vegetable oils, as disclosed herein above. Thus, in one embodiment, a method is provided of producing a firelighter, said method comprising

a) providing a one or more hydrogenated vegetable oils, a hydrogen source and catalyst
b) combining said one or more hydrogenated vegetable oils, hydrogen source and catalyst
c) incubating said combined one or more hydrogenated vegetable oils, hydrogen source and catalyst for a sufficient amount of time and at a suitable temperature and pressure to produce a hydrogenated vegetable oil
d) obtaining said hydrogenated one or more vegetable oils or mixtures thereof and providing a solidifying treatment.

[0059] In a preferred embodiment, the hydrogen source is H_2.

[0060] The catalyst is preferably a metal catalyst such as nickel.

[0061] The combined vegetable oil, hydrogen source and catalyst are incubated for a sufficient amount of time to allow hydrolysing a sufficient amount of double bonds in any unsaturated carboxylic acid comprised in the vegetable oil.

[0062] The solidifying treatment is in a preferred embodiment, to combine the one or more hydrogenated vegetable oils with a curable resin and curing the composition as described herein above.

[0063] In another embodiment, the one or more hydrogenated vegetable oils are solidified by compression techniques into cubic tablets.

After solidification or under solidication, the firelighter can be molded or divided into appropriate sizes for domestic firelighters. For example, the firelighter composition comprising a curable resin can be cured in molds having a corresponding size of domestic firelighters. Alternatively, the firelighter block can be divided subsequent to curing.

[0064] In one embodiment, such firelighters measure 0.5-3 cm x 1-5 cm x 1-10 cm and the method therefore comprises dividing the firelighters into blocks of such sizes.

[0065] The vegetable oil provided for use in the above method can be any of those mentioned herein above. In one embodiment, the vegetable oil is selected from the group consisting of coconut, corn, cottonseed, olive, palm, peanut, rape, rapeseed, safflower, sesame, soybean, jatropha and sunflower oils. In a preferred embodiment, the vegetable oil is rape oil, rapeseed oil, soybean oil, jatropha or sunflower oil. In another embodiment, the vegetable oil is a nut oil, such as oil extracted from almond, cashew, hazelnut, macadamia, mongongo, pecan, pine, pistachio, and walnut. In yet another embodiment, the vegetable oil of the present invention is extracted from Castor, Coconut, Corn, Cottonseed, False, Hemp, Mustard, Palm, Peanut, Radish, Rapeseed, Ramtil, Rice, Safflower, Salicornia, Soybean, Sunflower, and/or Tung.

[0066] The method for producing a firelighter may additionally comprise a transesterification step, where ester bonds in triglyceride molecules in the vegetable oil are broken and carboxylic acid sidechains may be released from the glycerol backbone. Thus, the vegetable oil may also be subject to transerification, which may be done before or after or during the hydrogenation step. Transerification typically requires providing an alcohol and a catalyst, such as an acid or base catalyst or an enzymatice biocatalyst.

[0067] In another embodiment, the method also comprises isomerization of carboxylic acids comprised in the vegetable oil.

[0068] The method of the invention for manufacture of a firelighter also in specific embodiments comprises adding one or more additional components. Additional components are described herein above, and is for example selected from lubricants, emulsifiers, wetting agents, densifiers, fluid-loss additives, corrosion inhibitors, oxidation inhibitors, friction modifiers, demulsifers, anti-wear agents, anti- foaming agents, detergents, rust inhibitors and the like. Furthermore, other hydrocarbonaceous fuels may be added to the firelighter, provided that the final blend has the appropriate physical properties, such as flash point, viscosity, curability and toxicity properties to allow for a suitable firelighter.

[0069] In other embodiments, the methods of the present invention further comprise adding at least one additional component, for example for the purpose of facilitating the production of the firelighter, reducing the cost, or otherwise

increasing the function or value of the firelighter. In one embodiment, the additional component is an inorganic material, such as a material selected from the group consisting of felatar, chalk, limestone, sand, talc, fule's earth, bentonite, fly ash, fillite, perlite, vermiculite, mica, calcium carbonate, sodium bicarbonate. In another embodiment, the additional component is a perfume, scent and/or a colorant.

[0070] In further embodiments, solids may be added to the firelighter. Such solids (particulate) may be other fuels e.g. coal, peat; or they may be added to control combustion or to optimize raw material cost savings and may comprise, for example, sand.

Use of hydrogenated vegetable oils as a firelighter or lamp fuel

[0071] The present invention in one aspect provides a use of one or more hydrogenated vegetable oils as a firelighter or lamp fuel. The choice of hydrogenated vegetable oil may be selected from any of those disclosed herein above. In a preferred embodiment, the hydrogenated vegetable oil has an iodine value of below 50, such as more preferred below 25. Most preferred, the iodine value is below 20 or even below 15.

[0072] As mentioned elsewhere herein, the firelighter is preferably a cubic tablet.

Method of lighting a burnable material

[0073] In one aspect, a method is provided herein for lighting a burnable material. This method comprises

a) providing a burnable material
b) providing a firelighter comprising one or more hydrogenated vegetable oils
c) placing said firelighter in contact or in the vicinity of said burnable material
d) lighting said firelighter, and
e) allowing said firelighter to burn for a sufficient amount of time to light said burnable material.

[0074] In this method, the firelighter comprising one or more hydrogenated vegetable oils may be selected from any such firelighters defined herein above.

[0075] The burnable material is for example charcoals, such as barbeque charcoals or wood of any sort. The method can be used for lighting barbeques, stoves, fireplaces, hearths and the like.

Lamp fuel

[0076] The present invention in one aspect provides a lamp fuel comprising one or more hydrogenated vegetable oils.

[0077] In a preferred embodiment, the lamp fuel comprises at least 40% by weight, such as at least 45%, for example at least 50%, such as at least 55%, for example at least 60%, such as at least 65%, for example at least 70%, such as at least 75%, for example at least 80% such as at least 85%, for example at least 90%, such as at least 95%, for example at least 99% by weight of one or more hydrogenated vegetable oils. In one embodiment, the lamp fuel comprises 100% by weight of one or more hydrogenated vegetable oils.

[0078] In one embodiment, the lamp fuel comprises by weight 10-100%, such as 10-20%, 20-30%, 30-40%, 40-50%, 50-60%, 60-70%, 70-80%, 80-90%, or 90-100%, of one or more hydrogenated vegetable oils. In another embodiment, the lamp fuel comprises by weight 10-100%, such as 20-100%, 20-90%, 30-80%, 40-80%, 50-80%, 60-80%, 60-75%, or 60-70%, of one or more hydrogenated vegetable oils.

[0079] The lamp fuel is liquid at room temperature and preferably has a melting point below 0°C. In particular, the lamp fuel is in a liquid state in any normal temperature range for the use of a lamp fuel or lighter fluid composition. Thus, the lamp fuel is preferably in a liquid state in the temperature range from -30 to 300°C, or for example from -15 to 200 °C, or -10 to 100 °C. In particular, the lamp fuel has a melting point of less than 0°C; the melting point is for example below -5°C, such as below -10°C, for example between -15°C.

[0080] An important feature of a lamp fuel is the soot emission. It is of course desirable that the soot emission of a lamp oil is kept to a minimum. Therefore, the soot index of a lamp fuel of the present invention is preferably below 100 Si/h, for example below 50 Si/h, such as below 40 Si/h, for example below 30 Si/h, such as below 20 Si/h, for example below 10 Si/h, such as below 5 Si/h, for example below 4 Si/h, such as below 3 Si/h, for example below 2 Si/h, such as below 1 Si/h, for example below 0.5 Si/h. The soot index of a lamp fuel of the present invention is preferably in the range from 0.01 to 0.90 Si/h.

[0081] The viscosity is also an important factor for the use of a composition as a lamp fuel; i.e. the use of a lamp fuel composition/lamp oil, since the viscosity of the composition determines the distance that the composition can travel in a wick from the surface of the fuel composition to the top of the wick, where the combustion occurs. Thus, there is a direct correlation between the lamp fuel viscosity and capillary effect, and between lamp fuel viscosity and wick compo-

sition (such as wick diameter, structure and composition, e.g. cotton or synthetic fibre). A small wick diameter allows a lamp fuel with a relatively low viscosity to travel through the wick, whereas more viscous composition travel relatively poor in a small diameter wick.

[0082] In general, viscosity is a measure of the resistance of a fluid which is being deformed by either shear stress or extensional stress. In everyday terms (and for fluids only), viscosity is "thickness". Thus, water is "thin", having a lower viscosity, while honey is "thick" having a higher viscosity. Viscosity describes a fluid's internal resistance to flow and may be thought of as a measure of fluid friction. Viscosity can be indicated by a viscosity coefficient. For example, Dynamic viscosity (or absolute viscosity) determines the dynamics of an incompressible Newtonian fluid, and the Kinematic viscosity coefficient is the dynamic viscosity divided by the density for a Newtonian fluid. The cgs (centimetre-gram-second system) physical unit for dynamic viscosity is the poise (P), named after Jean Louis Marie Poiseuille. It is more commonly expressed, particularly in ASTM standards, as centipoise (cP). 1 P = 1 g·cm-1·s-1. Water at 20 °C has a viscosity of 1.0020 cP. The higher (and the cP value), the higher is the viscosity.

[0083] The cgs physical unit for kinematic viscosity is stokes (St), named after George Gabriel Stokes. It is sometimes expressed in terms of centistokes (cSt or ctsk). 1 cSt = 1 mm2·s-1 = 10-6m2·s-1. Water at 20 °C has a kinematic viscosity of about 1 cSt

[0084] Thus, an important characteristic of the lamp fuel of the present invention is the viscosity. The viscosity of the composition allows for transport of the composition in a wick by capillary transport. A highly viscous lamp fuel will not transfer by capillary force in a normal oil lamp wick, and thus lamp fuels with a dynamic viscosity which is higher than about 10 cP, such as 15 cP, such as higher than about 20 cP can be less suitable as lamp fuel.

[0085] The viscosity of a liquid depends on the temperature of the liquid. The relevant measure of viscosity of a composition of the present invention is the viscosity at the temperature, at which the composition would normally be used as a lamp oil. Therefore, the viscosity for a lamp oil should be optimal to allow sufficient transport in a wick at temperatures ranging from -20°C to about 30°C. The composition of the present invention for use as a fuel, such as a lamp fuel has in certain embodiments a dynamic viscosity at 20°C, which is less than 10 cPoise (cP), such as less than 5 cP, such as less than 4 cP. In one embodiment, the dynamic viscosity is 1-10 cP, for example 2-8 cP, such as less than 3-8 cP, for example less than 4-8 cP at 20°C and at 4 mmHg.

[0086] The kinematic viscosity of the lamp fuel of the present invention may also be used to define the composition. Thus, in one embodiment, the kinematic viscosity of the lamp fuel as measured at 4 mmHg and 22° C is below 15 cSt, such as below 10 cSt, for example below 5 cSt. More preferred, the viscosity is between 1-10 cSt, such as 2-8 cSt.

[0087] The relevant viscosity of the lamp fuel is the viscosity measured at the temperature at which the composition is intended for use as a lamp fuel, which is for example broadly in the temperature range from about -10°C to about 40°C, but most commonly between 15 to 25°C. The viscosity always decreases with increasing temperature, and thus, the viscosity of a liquid composition at 40°C is significantly lower than the viscosity of the same liquid composition at 20°C. For example, a liquid which has a viscosity of 2 cSt at 40°C has a significantly higher viscosity when measure at 20°C. The composition of the present invention for use as a lamp oil has a preferred viscosity of about 2 cSt at 20 °C. However, viscosity is sometimes as a standard measured at 40°C. Since viscosity depends on the temperature of the liquid, the viscosity of a lamp fuel measured at 40°C is lower than the viscosity indicated above at 20°C.

[0088] Thus, the composition preferably has a viscosity that resembles water, and is liquid at temperatures above -5 degrees Celsius. However, the viscosity and physical state of the composition may vary depending on the specific components of the composition, for example on the choice of hydrogenated vegetable oil and the relative concentration of any other components of the lamp fuel.

[0089] The flash point of a flammable liquid is the lowest temperature at which it can form an ignitable mixture in air. The flash point of liquids and compositions are important for safety during transport and storage of fuels and compositions. Thus, the higher the flash point, the safer it is to store and transport the liquid/composition. The flash point of the lamp fuels of the present invention is thus preferably above 50°C, such as preferably above 60 degrees Celsius. In a preferred embodiment, the flash point of the lamp fuel is between 60°C and 100°C, such as between 60 -70°C, 70-80°C, or 80-90°C, or 90-100°C Celsius. The components of the lamp fuel of the present invention are, thus, mixed in appropriate ratios in order to obtain a suitable flash point.

A liquid candle

[0090] The present invention also in one aspect provides a liquid candle comprising a lamp fuel comprising one or more hydrogenated vegetable oils as defined herein above. The liquid candle also comprises a wick, such as a cotton wick.

Items

[0091] The following items represent preferred embodiments of the present invention

1. A firelighter or lamp fuel comprising one or more hydrogenated vegetable oils.
2. The firelighter of claim 1, wherein said firelighter further comprises a curable resin.
3. The firelighter or lamp fuel according to any of the preceding claims, wherein said firelighter or lamp fuel comprises 20-95% by weight one or more hydrogenated vegetable oils or mixtures thereof.
4. The firelighter or lamp fuel according to any of the preceding claims, wherein said firelighter or lamp fuel comprises at least 60% by weight one or more hydrogenated vegetable oils or mixtures thereof.
5. The firelighter or lamp fuel according to any of the preceding claims, wherein said vegetable oil is selected from coconut, corn, cottonseed, olive, palm, peanut, rape, rapeseed, safflower, sesame, soybean, jatropha and sunflower oils. In a preferred embodiment, the vegetable oil is rape oil, rapeseed oil, soybean oil, jatropha or sunflower oil. In another embodiment, the vegetable oil is a nut oil, such as oil extracted from almond, cashew, hazelnut, macadamia, mongongo, pecan, pine, pistachio, and walnut. In yet another embodiment, the vegetable oil of the present invention is extracted from Castor, Coconut, Corn, Cottonseed, False, Hemp, Mustard, Palm, Peanut, Radish, Rapeseed, Ramtil, Rice, Safflower, Salicornia, Soybean, Sunflower, and/or Tung.
6. The firelighter or lamp fuel according to any of the preceding claims, wherein said firelighter comprises hydrogenated rapeseed oil.
7. The firelighter or lamp fuel according to any of the preceding claims, wherein said firelighter or lamp fuel comprises C6-C18 carboxylic acids, in particular C16 or C18, such as C16:0, C18:0, C18:1, C18:2, C18:3 or C18:4.
8. The firelighter or lamp fuel according to any of the preceding claims, wherein said one or more hydrogenated vegetable oil has an iodine value of below 25.
9. The firelighter or lamp fuel according to any of the preceding claims, wherein said one or more hydrogenated vegetable oil has an iodine value of below 15.
10. The firelighter according to any of the preceding claims, wherein said firelighter is cubic tablet.
11. The firelighter according to any of the preceding claims, wherein firelighter measures 0.5-3 cm x 1-5 cm x 1-10 cm.
12. A method of producing a firelighter, said method comprising

    a) providing one or more vegetable oils or mixtures thereof, a hydrogen source and catalyst
    b) combining said one or more vegetable oils or mixtures thereof, hydrogen source and catalyst
    c) incubating said combined one or more vegetable oils or mixtures thereof, hydrogen source and catalyst for a sufficient amount of time to produce a hydrogenated vegetable oil
    d) obtaining said hydrogenated one or more vegetable oils or mixtures thereof and providing a solidifying treatment.

13. The method according to claim 12, wherein hydrogen source is H2.
14. The method according to any one of claims 12 to 13, wherein said catalyst is nickel
15. The method according to any one of claims 12 to 14, wherein said combined vegetable oil, hydrogen source and catalyst are incubated for a sufficient amount of time to allow hydrolysing a sufficient amount of double bonds in any unsaturated carboxylic acid comprised in the vegetable oil.
16. The method according to any one of claims 12 to 15, said method further comprising isomerization of carboxylic acids sidechains.
17. The method according to any one of claims 12 to 16, wherein said vegetable oil is selected from the group consisting of coconut, corn, cottonseed, olive, palm, peanut, rape, rapeseed, safflower, sesame, soybean, jatropha and sunflower oils. In a preferred embodiment, the vegetable oil is rape oil, rapeseed oil, soybean oil, jatropha or sunflower oil. In another embodiment, the vegetable oil is a nut oil, such as oil extracted from almond, cashew, hazelnut, macadamia, mongongo, pecan, pine, pistachio, and walnut. In yet another embodiment, the vegetable oil of the present invention is extracted from Castor, Coconut, Corn, Cottonseed, False, Hemp, Mustard, Palm, Peanut, Radish, Rapeseed, Ramtil, Rice, Safflower, Salicornia, Soybean, Sunflower, and/or Tung.
18. The method according to any one of claims 12 to 17, wherein said firelighter is molded by compression techniques into a cubic tablet.
19. The method according to claim 18, wherein said firelighter measures 0.5-3 cm x 1-5 cm x 1-10 cm.
20. Use of one or more hydrogenated vegetable oils as a firelighter or lamp fuel.
21. The use according to claim 20, wherein said firelighter or lamp fuel comprises hydrogenated rapeseed oil.
22. The use according to any of the preceding claims 20 to 21, wherein said one or more hydrogenated vegetable oil has an iodine value of less than 15.
23. The use according to any of the preceding claims 20 to 22, wherein said firelighter is cubic tablet.
24. A method of lighting a burnable material, said method comprising

    a) providing a burnable material
    b) providing a firelighter comprising one or more hydrogenated vegetable oils

c) placing said firelighter in contact or in the vicinity of said burnable material
d) lighting said firelighter, and
e) allowing said firelighter to burn for a sufficient amount of time to light said burnable material.

25. The method according to claim 24, wherein said firelighter is selected from a firelighter as defined in any of the preceding claims.
26. A liquid candle comprising a lamp fuel comprising one or more hydrogenated vegetable oils and a wick.
27. The liquid candle according to claim 26, wherein said lamp fuel is selected from a lamp fuel as defined in any of the preceding claims.

Claims

1. A firelighter or lamp fuel comprising one or more hydrogenated vegetable oils.

2. The firelighter of claim 1, wherein said firelighter further comprises a curable resin.

3. The firelighter or lamp fuel according to any of the preceding claims, wherein said firelighter or lamp fuel comprises at least 60% by weight one or more hydrogenated vegetable oils or mixtures thereof.

4. The firelighter or lamp fuel according to any of the preceding claims, wherein said vegetable oil is selected from coconut, corn, cottonseed, olive, palm, peanut, rape, rapeseed, safflower, sesame, soybean, jatropha and sunflower oils. In a preferred embodiment, the vegetable oil is rape oil, rapeseed oil, soybean oil, jatropha or sunflower oil. In another embodiment, the vegetable oil is a nut oil, such as oil extracted from almond, cashew, hazelnut, macadamia, mongongo, pecan, pine, pistachio, and walnut. In yet another embodiment, the vegetable oil of the present invention is extracted from Castor, Coconut, Corn, Cottonseed, False, Hemp, Mustard, Palm, Peanut, Radish, Rapeseed, Ramtil, Rice, Safflower, Salicornia, Soybean, Sunflower, and/or Tung.

5. The firelighter or lamp fuel according to any of the preceding claims, wherein said one or more hydrogenated vegetable oil has an iodine value of below 15.

6. The firelighter according to any of the preceding claims, wherein firelighter measures 0.5-3 cm x 1-5 cm x 1-10 cm.

7. A method of producing a firelighter, said method comprising

a) providing one or more vegetable oils or mixtures thereof, a hydrogen source and catalyst
b) combining said one or more vegetable oils or mixtures thereof, hydrogen source and catalyst
c) incubating said combined one or more vegetable oils or mixtures thereof, hydrogen source and catalyst for a sufficient amount of time to produce a hydrogenated vegetable oil
d) obtaining said hydrogenated one or more vegetable oils or mixtures thereof and providing a solidifying treatment.

8. The method according to claim 7, wherein hydrogen source is H_2.

9. The method according to any one of claims 7 to 8, wherein said catalyst is nickel

10. The method according to any one of claims 7 to 9, said method comprising the additional step of providing a curing agent and curing said obtained hydrogenated one or more vegetable oils.

11. The method according to any one of claims 7 to 10, wherein said firelighter is divided into blocks measuring 0.5-3 cm x 1-5 cm x 1-10 cm.

12. Use of one or more hydrogenated vegetable oils as a firelighter or lamp fuel.

13. The use according to claim 12, wherein said firelighter or lamp fuel comprises hydrogenated rapeseed oil.

14. A method of lighting a burnable material, said method comprising

a) providing a burnable material
b) providing a firelighter comprising one or more hydrogenated vegetable oils
c) placing said firelighter in contact or in the vicinity of said burnable material
d) lighting said firelighter, and
e) allowing said firelighter to burn for a sufficient amount of time to light said burnable material.

15. A liquid candle comprising a lamp fuel comprising one or more hydrogenated vegetable oils and a wick.

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EUROPEAN SEARCH REPORT

Application Number
EP 15 19 6798

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
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