

FUEL ADDITIVE COMPOSITIONS AND METHODS FOR MAKING THE SAME AND EMULSION FUEL COMPRISING THE FUEL ADDITIVE COMPOSITIONS

Field of the Invention

[0001] The present invention generally relates to the emulsion fuel technologies, and more particularly to the process of manufacturing biodiesel and glycerin, fuel additive compositions and emulsion fuels, and the fuel additive compositions and emulsion fuels manufactured by said process.

Background of the Invention

[0002] The facts that fossil fuels including petroleum are running out and the demands for energy supplies are skyrocketing are well known. The pollution of the environment due to the burns of fossil fuel has resulted in the increased health problems and more alarmingly the global warming. Amidst the oil crisis in 2008, many countries implemented a variety of strategies to increase fuel efficiency and develop alternative fuel supplies such as biodiesel, hoping to obtain sustainable fuels that are enable the humans to be less dependent upon fossil fuels and at the same time reduce the pollution so as to at least slow down the process of global warming.

[0003] For the increase of fuel efficiency especially in internal combustion engines, many fuel additives have been developed; some of them have been available in the market for many years. However, most of the available fuel additives contain harmful chemicals such as benze and its derivatives; while giving the benefit of doubt to the claims of enhanced fuel efficiency, the detrimental effects from these added benze and its derivatives on public health and ozone deficiency cannot be overstated.

[0004] For the reduction of environmental pollution, water-based emulsion diesel has been used in the Europe for many years. While the water-based emulsion diesel reduces environmental pollution especially black smokes, it suffers from the decreased fuel power and the higher cost incurred in the manufacture process.

[0005] Biodiesel is usually derived from vegetable oil; it pushes the prices of vegetable oils higher, burdening the citizens of poor countries. Furthermore, current technologies in

manufacturing biodiesel from vegetable oils focus on the recovery of fatty esters, leaving the glycerin entity out of the biodiesel process.

[0006] It is evident that current approaches to fuel shortage, fuel efficiency and pollution are fragmented. Therefore, there is a need to develop an integrated strategy for addressing the aforementioned problems together.

Summary of the Invention

[0007] One embodiment of the present invention provides a fuel additive composition. In one embodiment, the fuel additive composition comprises glycerin in an amount of 40-80% of the composition, fatty alcohol in an amount of 5-15% of the composition, diesel in an amount of 5-15% of the composition, water in an amount of 5-15% of the composition, and a dilutant in an amount of 20-40% of the composition; whereby all components are admixed together to form the fuel additive composition.

[0008] In another embodiment of the fuel additive composition, the glycerin has over 85% purity, and preferably 60-80% of the composition, and further preferably 70-80% of the composition.

[0009] In another embodiment of the fuel additive composition, the fatty alcohol is selected from ethanol, or long chain alcohols with 10, 12 or 14 carbons. In a further embodiment of the fuel additive composition, the fatty alcohol is preferably about 8-12% of the composition.

[0010] In another embodiment of the fuel additive composition, the diesel is fossil diesel, biodiesel or combination, and ; preferably 5-10% of the composition.

[0011] In another embodiment of the fuel additive composition, the water has a pH value between 6.8 to 7.2, and is preferably 8-10% of the composition.

[0012] In another embodiment of the fuel additive composition, the dilutant is sobitol, and preferably 25-35% of the composition.

[0013] In another embodiment of the fuel additive composition, the composition optionally comprises 5-15% of fossil diesel, xylene or toluene or in combination.

[0014] In another embodiment of the fuel additive composition, the glycerin is manufactured by the process comprising providing a suitable vegetable oil for processing; adding alcohol and catalyst into the vegetable oil to form a mixture; heating the mixture to

a predetermined temperature for a predetermined time period; separating the heated mixture into two fractions: fraction A and fraction B; and neutralizing the fraction B with an inorganic or organic acid substance to have a neutral pH value, and then heating the fraction B to a predetermined temperature, and then distilling to get the glycerin.

[0015] Another embodiment of the present invention provides an emulsion fuel. In one embodiment, the emulsion fuel comprises fossil diesel in an amount of 60-80% of the emulsion fuel, water in an amount of 10-25% of the emulsion fuel, and fuel additive composition in an amount of 10-25% of the emulsion fuel; wherein the fuel additive composition comprises glycerin in an amount of 40-80% of the composition, fatty alcohol in an amount of 5-15% of the composition, diesel in an amount of 5-15% of the composition, water in an amount of 5-15% of the composition, and a dilutant in an amount of 20-40% of the composition; whereby all components are admixed together to form the emulsion fuel.

[0016] In another embodiment of the emulsion fuel, the glycerin has over 85% purity, and preferably 60-80% of the composition, and further preferably 70-80% of the composition.

[0017] In another embodiment of the emulsion fuel, the fatty alcohol is selected from ethanol, or long chain alcohols with 10, 12 or 14 carbons.

[0018] In another embodiment of the emulsion fuel, the fatty alcohol is preferably about 8-12% of the composition.

[0019] In another embodiment of the emulsion fuel, the diesel is fossil diesel, biodiesel or combination, and ; preferably 5-10% of the composition.

[0020] In another embodiment of the emulsion fuel, the water has a pH value between 6.8 to 7.2, and is preferably 8-10% of the composition.

[0021] In another embodiment of the emulsion fuel, the dilutant is sobitol, and preferably 25-35% of the composition.

[0022] In another embodiment of the emulsion fuel, the composition optionally comprises 5-15% of fossil diesel, xylene or toluene or in combination.

[0023] In another embodiment of the emulsion fuel, the glycerin is manufactured by the process comprising providing a suitable vegetable oil for processing, adding alcohol and catalyst into the vegetable oil to form a mixture, heating the mixture to a predetermined temperature for a predetermined time period, separating the heated mixture into two

fractions: fraction A and fraction B, and neutralizing the fraction B with an inorganic or organic acid substance to have a neutral pH value, and then heating the fraction B to a predetermined temperature, and then distilling to get the glycerin.

[0024] In another embodiment of the emulsion fuel, the fossil diesel is preferably about 65-75%; water is preferably about 12-18%; and fuel bio-additive composition is preferably 12-18%.

[0025] Another embodiment of the present invention provides a process for processing vegetable oil to obtain glycerin, fatty alcohol and biodiesel. In one embodiment, the process comprises providing a suitable vegetable oil for processing; adding alcohol and catalyst into the vegetable oil to form a mixture; heating the mixture to a predetermined temperature for a predetermined time period; separating the heated mixture into two fractions: fraction A and fraction B; neutralizing the fraction A with an inorganic or organic acid substance to have a neutral pH value, and initially distilling at a low temperature to produce fatty alcohol, and further distilling at a high temperature to produce ester (biodiesel); whereby the biodiesel is suitable for being used directly as fuel for internal combustion engines; and neutralizing the fraction B with an inorganic or organic acid substance to have a neutral pH value, and then heating the fraction B to a predetermined temperature, and then distilling to get glycerin.

[0026] In another embodiment of the process, the vegetable oil has a content of free fatty acid less than 2.5%; preferably less 1.0%; more preferably less 0.5%.

[0027] In another embodiment of the process, the the alcohol is methanol, ethanol or long chain alcohols with 10, 12 or 14 carbons, and the catalyst is potassium hydroxide or sodium hydroxide.

[0028] In another embodiment of the process, the alcohol and catalyst are preferably in equal molar ratio; and the ratio of the vegetable oil and the alcohol/catalyst is preferably 4-6 to 1, more preferably 5 to 1.

[0029] In another embodiment of the process, the vegetable oil is palm oil; the temperature is about 70-80 °C; and the heating duration is about 20-30 minutes.

[0030] In another embodiment of the process, the inorganic acid is phosphoric acid, and the organic acid is citrus acid.

[0031] The objectives and advantages of the invention will become apparent from the following detailed description of preferred embodiments thereof in connection with the accompanying drawings.

Brief Description of the Drawings

[0032] Preferred embodiments according to the present invention will now be described with reference to the Figures, in which like reference numerals denote like elements.

[0033] FIG 1 is a block diagram showing the process and products produced by the process in accordance with one embodiment of present invention.

Detailed Description of the Invention

[0034] The present invention may be understood more readily by reference to the following detailed description of certain embodiments of the invention.

[0035] Throughout this application, where publications are referenced, the disclosures of these publications are hereby incorporated by reference, in their entireties, into this application in order to more fully describe the state of art to which this invention pertains.

[0036] The present invention provides processes for processing vegetable oils to obtain esters (biodiesel), fatty alcohol and glycerin, fuel additive compositions, and emulsion fuels containing the fuel additive compositions, and further provides the fuel additive compositions and emulsion fuels manufactured by the process provided by the present invention.

[0037] Now referring to FIG 1, there is provided a block diagram showing the process and products produced by the process in accordance with one embodiment of the present invention. The clean refined vegetable oil **10** is any vegetable oil available for example palm oil; the vegetable oil does not require to be 100% pure; as long as the impurities existing in the vegetable oil do not interfere with the process of the present invention, the vegetable oil is suitable for use in the present invention. For example, the content of free fatty acid in the vegetable oil is critical for the process. Our inventors discovered that the content of the free fatty acid shall be less than 2.5% in the vegetable oil; preferably less 1.0%; more preferably less 0.5%.

[0038] The vegetable oil is first processed **20** by adding alcohol and catalyst; all materials are mixed and heated to a predetermined temperature for a predetermined time period. The temperature and heating duration are dependent upon the used vegetable oil, alcohol and catalyst, and can be easily determined by one skilled in the art. When palm oil is used as the exemplary vegetable oil for the process of the present invention, the alcohol is methanol, ethanol or long chain alcohols with 10, 12 or 14 carbons; the catalyst is potassium hydroxide or sodium hydroxide; the temperature is about 70-80 °C; and the heating duration is about 20-30 minutes. It is preferred to have air injection during the process. The alcohol and hydroxides are preferably in equal molar ratio; the ratio of the vegetable oil and the alcohol/hydroxides is preferably 4-6 to 1, more preferably 5 to 1.

[0039] The processed mixture is then separated **30** into two fractions: fraction A and fraction B. As for fraction B **100**, it is about 10% of the total mixture with glycerin as its main component. The fraction B is first neutralized **110** with an inorganic or organic acid substance for example phosphoric acid or citrus acid to have a neutral pH value, and then refined with heating the fraction B to about 90-110 °C and distilling to get purified glycerin for further uses as discussed below.

[0040] With regard to fraction A **40**, it is about 90% of the total mixture with ester (biodiesel) as its main component. The fraction A is first neutralized **50** with an inorganic or organic acid substance for example phosphoric acid or citrus acid to have a neutral pH value, and initially distilled **60** at a low temperature for example 60-70 °C to produce fatty alcohol (product A2) **70**, and further distilled **80** at a high temperature for example 100-110 °C to produce refined biodiesel (product A1). The refined biodiesel can be used directly as fuel for internal combustion engines.

[0041] The fuel additive compositions in accordance with one aspect of the present invention comprise glycerin, fatty alcohol, biodiesel, water and a dilutant. In some embodiments, glycerin has over 85% purity, and is about 40-80% of the final composition, preferably about 60-80%, and further preferably 70-80%; fatty alcohol is about 5-15% of the final composition, preferably about 8-12%; biodiesel is about 5-15% of the final composition, preferably 5-10%; water is about 5-15% of the final composition, preferably 8-10%; the dilutant is about 20-40% of the final composition, preferably 25-35%. In some embodiments, the glycerin is manufactured by the process disclosed in the present invention. In some embodiments, the fatty alcohol is selected from ethanol, or long chain

alcohols with 10, 12 or 14 carbons. In some embodiments, the biodiesel is substituted by fossil diesel or a mixture of biodiesel and fossil diesel. In some embodiments, the water has a pH value between 6.8 to 7.2. In some embodiments, the dilutant is sobitol. The compositions optionally further comprise 5-15% of fossil diesel, xylene or toluene or in combination. In some embodiments, the fuel additive compositions disclosed herein are manufactured by admixing the glycerin, fatty alcohol, biodiesel, water, dilutant and optional fossil diesel or xylene or toluene together.

[0042] The emulsion fuel in accordance with one aspect of the present invention comprises fossil diesel, water and fuel additive composition as aforescribed. In some embodiments, fossil diesel is about 60-80% of the final emulsion fuel, preferably about 65-75%; water is about 10-25% of the final emulsion fuel, preferably about 12-18%; and fuel bio-additive composition is about 10-25%, preferably 12-18%. In some embodiments, the emulsion fuel is manufactured by admixing the fossil diesel, water and fuel additive compositions together.

[0043] The following examples are provided for the sole purpose of illustrating the principles of the present invention and better understanding of the scope of the present invention; they are by no means intended to limit the scope of the present invention.

[0044] Examples

[0045] Production and purification of glycerin from palm olein—protocol 1

[0046] 100kg of palm oil and 25 kg of methoxide were admixed and heated to 70 °C for 30 minutes, and the heated mixture were let to stand still for 8 hours; then the vapor 15 kg was recovered as methanol; the second fraction was 90kg of ester (biodiesel); the third fraction was 1g of dirt, soap and oil; the fourth fraction was 10 kg of glycerin with a minimal purity of 85%; and the last fraction was 1g of dirt, salt and water. The third and last fractions were discharged. The purified biodiesel and glycerin were used for further applications. The glycerin purified from the fourth fraction had a purity over 85%.

[0047] Production and purification of glycerin from palm olein—protocol 2

[0048] 100kg of palm oil, 1.5kg of sodium hydroxide, and 25kg of methanol were admixed and heated to 70 °C for 30 minutes, and the heated mixture were let to stand still for 8 hours; then the vapor 15 kg was recovered as methanol; the second fraction was 90kg of ester (biodiesel); the third fraction was 1g of dirt, soap and oil; the fourth fraction was 10kg of glycerin with a minimal purity of 85%; and the last fraction was 1g of dirt, salt and

water. The third and last fractions were discharged. The purified biodiesel and glycerin were used for further applications. The purified biodiesel and glycerin were used for further applications. The glycerin purified from the fourth fraction had a purity over 85%.

[0049] Composition A

[0050] 800g of glycerin (about 85% purity), 100g of pure water (pH 6.8-7.2), 100g of biodiesel, and 100g of ethanol were admixed well to produce composition A.

[0051] Composition A1

[0052] 800g of glycerin (about 85% purity), 100g of pure water (pH 6.8-7.2), 100g of biodiesel, and 100g of $\text{CH}_3(\text{CH}_2)_9\text{OH}$ were admixed well to produce composition A1.

[0053] Composition A2

[0054] 800g of glycerin (about 85% purity), 100g of pure water (pH 6.8-7.2), 100g of biodiesel, and 100g of $\text{CH}_3(\text{CH}_2)_{11}\text{OH}$ were admixed well to produce composition A1.

[0055] Composition A3

[0056] 800g of glycerin (about 85% purity), 100g of pure water (pH 6.8-7.2), 100g of biodiesel, and 100g of $\text{CH}_3(\text{CH}_2)_{13}\text{OH}$ were admixed well to produce composition A1.

[0057] Composition B

[0058] 700g of composition A and 300g of sobitol were admixed to produce composition B.

[0059] Composition B1

[0060] 700g of composition A1 and 300g of sobitol were admixed to produce composition B.

[0061] Composition B2

[0062] 700g of composition A2 and 300g of sobitol were admixed to produce composition B.

[0063] Composition B3

[0064] 700g of composition A3 and 300g of sobitol were admixed to produce composition B.

[0065] Composition C

[0066] 900g of composition B and 100g of diesel or xylene or toluene were admixed to produce composition C.

[0067] Composition C1

[0068] 900g of composition B1 and 100g of diesel or xylene or toluene were admixed to produce composition C.

[0069] Composition C2

[0070] 900g of composition B2 and 100g of diesel or xylene or toluene were admixed to produce composition C.

[0071] Composition C3

[0072] 900g of composition B3 and 100g of diesel or xylene or toluene were admixed to produce composition C.

[0073] Emulsion biodiesel

[0074] 10L of biodiesel, 2L of pure water, and 2L of composition B were admixed to produce emulsion biodiesel, where the composition B can be substituted by composition B1, composition B2, composition B3, composition C, composition C1, composition C2, and composition C3.

[0075] Table 1. General comparison between the commercially available ultra-low sulphur diesel (ULSD) and the emulsion biodiesel of the present invention

Features	ULSD	Emulsion biodiesel
Sulfur (S) %wt	0.005	0.001 to 0.005
Cetane Value	42-48	43.3-52.4
Flash Point (PMC) deg C	60-66	76-122
Carbon Residue % wt	0.2	0.001 to 0.02

[0076] Table 2. Smoke Emission Test

Fuel type	Ultra Low Sulfur Diesel		Emulsion Fuel	
Lug-Down Smoke test	RPM	Smoke Value (hsu)	RMP	Smoke Value (hsu)
At 100% of Engine Speed at Maximum Power	2328	19	2328	8
At 90% of Engine Speed at Maximum Power	2189	17	2189	7
At 80% of Engine Speed at Maximum Power	2096	32	2096	6

[0077] The emulsion biodiesel of the present invention has many advantages including: no modification to existing engines, no modification to existing infrastructures, reduction of harmful gas emission, reduction of smoke, improvement of engine performance and power, improvement of fuel consumption, and reduction of productivity down time.

[0078] While the present invention has been described with reference to particular embodiments, it will be understood that the embodiments are illustrative and that the invention scope is not so limited. Alternative embodiments of the present invention will become apparent to those having ordinary skill in the art to which the present invention pertains. Such alternate embodiments are considered to be encompassed within the spirit and scope of the present invention. Accordingly, the scope of the present invention is described by the appended claims and is supported by the foregoing description.

CLAIMS

What is claimed is:

1. A fuel additive composition, comprising:
glycerin in an amount of 40-80% by weight of the composition;
fatty alcohol in an amount of 5-15% by weight of the composition;
diesel in an amount of 5-15% by weight of the composition;
water in an amount of 5-15% by weight of the composition; and
a dilutant in an amount of 20-40% by weight of the composition;
whereby all components are admixed together to form the fuel additive composition.
2. The fuel additive composition of claim 1, wherein the glycerin has over 85% purity, and is in an amount of 60-80% by weight of the composition.
3. The fuel additive composition of claim 1, wherein the fatty alcohol is selected from ethanol, or long chain alcohols with 10, 12 or 14 carbons.
4. The fuel additive composition of claim 3, wherein the fatty alcohol is in an amount of 8-12% by weight of the composition.
5. The fuel additive composition of claim 1, wherein the diesel is fossil diesel, biodiesel or combination, and is in an amount of 5-10% by weight of the composition.
6. The fuel additive composition of claim 1, wherein the water has a pH value between 6.8 to 7.2, and is in an amount of 8-10% by weight of the composition.
7. The fuel additive composition of claim 1, wherein the dilutant is sorbitol, and in an amount of 25-35% by weight of the composition.

8. The fuel additive composition of claim 1, wherein the composition optionally comprises 5-15% of fossil diesel, xylene or toluene or in combination.
9. The fuel additive composition of claim 1, wherein the glycerin is manufactured by the process comprising:
 - providing a suitable vegetable oil for processing;
 - adding alcohol and catalyst into the vegetable oil to form a mixture;
 - heating the mixture to a predetermined temperature for a predetermined time period;
 - separating the heated mixture into two fractions: fraction A and fraction B; and
 - neutralizing the fraction B with an inorganic or organic acid substance to have a neutral pH value; and then heating the fraction B to a predetermined temperature, and then distilling to get the glycerin.
10. An emulsion fuel, comprising:
 - fossil diesel in an amount of 60-80% by weight of the emulsion fuel;
 - water in an amount of 10-25% by weight of the emulsion fuel; and
 - the fuel additive composition of claim 1 in an amount of 10-25% by weight of the emulsion fuel;whereby all components are admixed together to form the emulsion fuel.
11. The emulsion fuel of claim 10, wherein the glycerin has over 85% purity, and is in an amount of 60-80% by weight of the composition.
12. The emulsion fuel of claim 10, wherein the fatty alcohol is selected from ethanol, or long chain alcohols with 10, 12 or 14 carbons.
13. The emulsion fuel of claim 12, wherein the fatty alcohol is in an amount of 8-12% by weight of the composition.
14. The emulsion fuel of claim 10, wherein the diesel is fossil diesel, biodiesel or combination, and in an amount of 5-10% by weight of the composition.

15. The emulsion fuel of claim 10, wherein the water has a pH value between 6.8 to 7.2, and is in an amount of 8-10% by weight of the composition.
16. The emulsion fuel of claim 10, wherein the dilutant is sorbitol, and in an amount of 25-35% by weight of the composition.
17. The emulsion fuel of claim 10, wherein the composition further comprises 5-15% of fossil diesel, xylene or toluene or in combination.
18. The emulsion fuel of claim 10, wherein the glycerin is manufactured by the process comprising:
 - providing a suitable vegetable oil for processing;
 - adding alcohol and catalyst into the vegetable oil to form a mixture;
 - heating the mixture to a predetermined temperature for a predetermined time period;
 - separating the heated mixture into two fractions: fraction A and fraction B; and
 - neutralizing the fraction B with an inorganic or organic acid substance to have a neutral pH value, and then heating the fraction B to a predetermined temperature, and then distilling to get the glycerin.
19. The emulsion fuel of claim 10, wherein the fossil diesel is in an amount of 65-75% by weight of the emulsion fuel; the water is in an amount of 12-18% by weight of the emulsion fuel; and the fuel additive composition is in an amount of 12-18% by weight of the emulsion fuel.