

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
22 June 2006 (22.06.2006)

PCT

(10) International Publication Number
WO 2006/065958 A2

(51) International Patent Classification:
C10L 1/14 (2006.01)

(21) International Application Number:
PCT/US2005/045354

(22) International Filing Date:
14 December 2005 (14.12.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/636,416 14 December 2004 (14.12.2004) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: COMPOSITION AND METHODS FOR IMPROVED LUBRICATION, POUR POINT, AND FUEL PERFORMANCE

(57) Abstract: An additive includes polyalphaolefin (PAO), a calcium source, and one or more plant oils from, or components derived from, beans, seeds, or roots, such as castor oil, jojoba oil, rape (canola) seed oil, palm oil, coconut oil, sunflower oil, soybean oil, etc.. The preferred composition of matter comprises a calcium source, PAO, castor oil, jojoba oil, and a soy methyl ester and/or rape seed oil/ester. The additive may be used in fuels that improve combustion engine performance in terms of efficiency and emissions. The additive may be used in lubricants that improve performance of both ferrous and non-ferrous metal components of engines, guns, or other machinery. The additive also may be used in cutting fluids for machining and fabrication. Used in conjunction with other additives, embodiments of the invention may be used to lower pour points in oils, esters and other similar products.



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COMPOSITION AND METHODS FOR IMPROVED LUBRICATION,
POUR POINT, AND FUEL PERFORMANCE

DESCRIPTION

This application claims priority of U.S. Provisional Application Serial Number 60/636,416, filed December 14, 2004.

FIELD OF THE INVENTION

The invention relates to motor fuels or additives for motor fuels that improve combustion engine performance in terms of efficiency and emissions. The invention may also relate to lubricants or additives for lubricants that improve performance of both ferrous and non-ferrous metal components of engines, guns, or other machinery. The invention may also relate to cutting fluids or additives for cutting fluids used in machining and fabricating, as well as mining and other similar cutting, shearing, and grinding applications that benefit from ease of cutting and lower temperatures. The invention may also act as an enhancer of pour point depressant additives for fuels, oils, esters, grease, pasty compounds such as cosmetics, as well as other fluids and semi-solids.

BACKGROUND OF THE INVENTION

The present inventor, in U.S. Patent 5,505,867 (issued April 9, 1996), has disclosed compositions of matter for inclusion in fuels and lubricants that include overbased sulfonates, jojoba oil, and castor oil. The combination of these three components, when added to lube oils for metals, was found to provide superior

lubrication performance. The combination of these three components, when added to automotive diesel fuel, was found to provide superior power, lower fuel consumption, and lower smoke emissions. The combination of these three components, when added to 95 Research Octane gasoline, allowed a single-engine aircraft engine to perform without incipient detonation even while "leaning" the fuel by 20 – 25 %.

Many other patents and products attempt to improve engine performance and lube oil performance, with varying success. Many commercial products are available from the major oil companies and from smaller specialty producers that tout improved engine performance and life due to removal of deposits, prevention of deposits, lubrication of engine metal surfaces, removal of water droplets in fuel, or rust inhibition.

Even in view of the present inventor's previous invention, and in view of the many formulations available on the market, the present inventor still believes that improvement in lube oil and fuel additives and in methods of using the additives is needed. Embodiments of the present invention meet these and other needs.

SUMMARY OF THE INVENTION

The present invention comprises a composition of matter that improves combustion performance and reduces harmful emissions from combustion engines when added to fuels for said engines, or that improves lubricant performance when added to lubricants for metals. Preferred embodiments comprise polyalphaolefin (PAO), a calcium source, and one or more plant oils (liquid vegetable/plant fats, carboxylic esters) blended together as an additive for fuels and lubricants. Said plant oil components may be derived, for example, from beans, seeds, roots, or other vegetable and plant portions, and may include, for example, castor oil, jojoba oil, rape seed (canola) oil, palm oil, sunflower oil, coconut oil, soybean oil, and soybean oil methyl and ethyl ester. The preferred composition of matter comprises a calcium source, PAO, castor oil, jojoba oil, and soy methyl (or ethyl) ester and/or canola oil.

Alternatively, another preferred composition of matter comprises a calcium source, PAO, castor oil, and jojoba oil, with or without soy methyl or ethyl ester, blended together for addition to preferably a soy-based fuel or soy-containing fuel, for example, soy methyl (or ethyl) ester "biodiesel." Preferably, the fuel based on or containing said soy-based esters preferably contains a pour point depressant, or, most preferably, the additive is formulated for addition to the pour point depressant that is then added to a biodiesel.

A preferred method comprises reducing harmful emissions, particularly NO_x, from vehicles and stationary engines, by adding the invented composition of matter to stationary and non-stationary combustion engine fuels, including diesel fuel, gasoline fuel, two-stroke cycle fuel, aviation fuels, and ship fuels. The inventor believes that embodiments of the invented additive may work well to meet the EPA mandates for 2006 regarding ultra-low sulfur diesel fuel and gasoline fuels to enhance combustion, improve lubrication/anti-wear properties, and reduce a variety of toxic emissions. The inventor also expects that embodiments of the invented additive will be effective in ethanol E85 fuel that is currently sold in some regions, which fuel is approximately 85 % ethanol.

Embodiments of the invented composition of matter may work well as an additive in lubricants for ferrous and non-ferrous metals, plastics, composites, and other substances, for example, liquid or solid lubricants and greases or anti-corrosion treatments for guns and other machinery. The composition of matter also may be used in cuttings fluids.

Embodiments of the invented additive may work well to meet mandates for including biodiesel in conventional petroleum diesel fuels, by means of the additive supplementing/enhancing pour point depression most preferably via addition to a conventional pour point depressant used in the biodiesel or less preferably via direct addition to the biodiesel preferably already containing pour point depressant. As an enhancer of pour point depressants, embodiments of the invented additive may be used in combination with conventional pour point depressants that are in and of themselves not effective, or minimally effective, for lowering the pour point of bean oils, seed oils, animal oils, esters, and other oils, fuels including such oils, and other

fuels. The combination of the additive plus conventional pour point depressants greatly suppresses pour point in the above-mentioned oils and fuels, for example, making handling and storage of these substances much easier and feasible even in cold climates. In the case of pasty substances such as fats, cosmetics and similar substances, embodiments of the invention may help maintain a softer more pliable solid at lower temperatures.

The inventor also envisions that the invented composition of matter may be used in other materials that are currently in use or that may be in use in the future.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Various embodiments of the invented composition may be formulated for use alone, blended into fuels, lubricants, treatments, or cutting oils, or blended into additives or pour point depressants for said fuel, lubricants, treatments, or cuttings. Various embodiments of the invented composition may be used to treat various surfaces and improve combustion and/or operation of combustion engines. In this way, machinery and equipment operates with less wear and failure and with more efficiency. Combustion engines operate with less wear and failure, more efficiency, and/or lower pollutant emissions.

Of particular interest and benefit is that embodiments of the invented composition of matter reduce harmful emissions from combustion fuels a surprising amount. NO_x, VOC's, HC, smoke, and odor are reduced, even with small amounts of the composition of matter added to the fuels under study. The inventor believes that there is a synergistic effect from the invented composition of matter, specifically, treatment of the metal engine surfaces and improvement of combustion characteristics that together result in greatly improved and cleaner engine performance. The immediate effect is seen in terms of reduced harmful and unpleasant emissions, and the longer-term effect is seen in that metal surfaces appear to be changed, at least temporarily, so that an engine run with the invented additive in its fuel continues to

exhibit improved performance (compared to pre-additive operation) even when changed back to the original (pre-additive) fuel.

The preferred embodiments include polyalphaolefin (PAO); a calcium source; and preferably a plurality of plant oil components (liquid vegetable/plant fats, carboxylic esters), for example, from bean oils, seed oils, or root oils. These preferred components are discussed below.

The calcium source is preferably a liquid and may be a calcium sulfonate, such as an overbased calcium sulfonate, but the inventor envisions that other calcium-containing molecules may be used. Many calcium sulfonates and overbased calcium sulfonates are known (see, for example, U.S. Patent 5,505,867 Related Art), and are available commercially, for example, from Crompton Corporation/Great Lakes Corporation (Chemtura). Particularly preferred calcium sources are C-400™ or C-400-C™ overbased calcium sulfonates from Crompton Corporation/Great Lakes Corporation (Chemtura). C-400™ and C-400-C™ have been found to be excellent calcium sources in the form of liquids that do not exhibit calcium particle size problems by plugging fuel filters.

The preferred combination of plant oils (liquid vegetable/plant fats, carboxylic esters) are bean, seed and root oils or derivatives thereof, and, most preferably, are castor oil, jojoba, and one or more oils selected from the following group: a soy oil or ester (ethyl, methyl, or other esters, most preferably soy methyl ester), canola (rape seed) oil or ester (preferably, rape seed methyl, ethyl or other esters), palm oil, coconut, and sunflower oil. The oil(s) selected from said group may be selected for obtaining the desired flow characteristics for the additive and/or for the desired lubrication, combustion, emissions, and pour point effects. While the inventor prefers soy methyl ester, one or more of the other oils may be substituted for, or added with, the soy methyl ester, preferably with the sum of the oils from this listed group (a soy oil/ester, canola (rape seed) oil/ester, palm oil, coconut, and sunflower oil) being present in an amount of about 5 – 45 LV % of the additive. For example, alternatives to the preferred soy methyl ester that the inventor envisions are canola oil, or a soy methyl ester and canola blend.

While the inventor prefers polyalphaolefin, castor oil, jojoba oil, soy methyl ester and calcium sulfonate, he also envisions that alternative components may be used, both crystalline and amorphous. As explained above, alternative calcium sources may be used. Alternative bean, seed, or root oils may be used, with at least one selected oils having being similar to castor oil and one selected oil being similar to jojoba oil. The inventor envisions that ethyl esters may be used in addition to, or instead of, methyl esters.

A wide range of formulations are expected to be effective for the additive, for example, within the following ranges:

- Group 1: Calcium component, 10 – 60 LV-%, such as Calcium sulfonate, including overbased calcium sulfonate;
- Group 2: Polyalphaolefins, 0.1 – 50 LV-%;
- Group 3: Castor oil or castor oil derivative, 0.1 – 40 LV-% such as castor oil and/or sulfated castor oil;
- Group 4: Jojoba Oil or similar wax oil/ester, 0.1 – 30 LV-%; and
- Group 5: Soy oil/ester, canola oil/ester, palm oil, coconut, and/or sunflower oil, 5 – 45 LV% (exceptions may include, for example, cases wherein the other four component groups are combined, with or without a pour point depressant, and added to biodiesel fuel, in which case the percentage of Group 5 in the “additive” may not be present (0.0 LV%) but, in the final biodiesel-plus-additive composition, may be very high, for example, 80 LV% or more).

When components from these five groups are blended together to form 100 liquid-volume-% of the additive, it is referred to as the “five-group additive” composition. In view of the above formulation ranges, the preferred additive may be said to be: 10 – 60 LV-% Group 1, 0.1 – 50 LV-% Group 2; and 5.2 – 89.9 LV% plant oil or mixture of plant oils from Groups 3-5. In some embodiments wherein Group 5 is not included in the additive, one may describe the preferred additive as: 10 – 60 LV-% Group 1, 0.1 – 50 LV-% Group 2; and 0.2 – 89.9 LV% plant oil or mixture of plant oils from Groups 3-4. In most embodiments, ranges are expected to be: 25 – 45 LV% Group 1 component(s); 15 – 40 LV% Group 2 component(s); 10 – 20 LV% Group 3

component(s); 1-5 LV% Group 4 component(s); and 5 – 45 LV% Group 5 component(s).

The blending process is best done by adding Group 4 to the Group 1 component(s), and blending these two components/groups very well before adding any other groups. After blending the first two groups, the Group 2 and 3 component(s), and finally the Group 5 component(s) may be added. A thorough blending of these components, before any other components are added, is believed by the inventor to be very important to keeping all the components of the additive in solution or suspension, and in keeping the additive in proper solution or suspension with the oil, fuel, or lubricant into which the additive is placed. While the components may be at a range of temperatures during the blending process, it is preferred that the components be blended at about room temperature up to about 100 – 140 degrees F.

The preferred five-group additive of calcium sulfonate, PAO, Castor oil, jojoba oil, and soy methyl ester and/or canola oil may be mixed with components of other “groups” or “families”, thus forming a “blended additive”. A blended additive may consist of, for example, 80 – 99.99 LV-% of the five group combination and 20 – 0.01 LV-% of “additional components.” Thus, the “additional components” may range from a significant portion of the product (at about 20 LV-%, for example) to a very small portion of the product (at about 0.01 LV-%, for example). Examples of components that may be added to the “five-group additive” to form a “blended additive” include, but are not limited to, a pour point suppressant, wintergreen oil, dyes, oil, various esters, and/or various conventional additive packages for fuels or for lubricants. Further, the five-group additive or the blended additive may be added/blended with other materials, preferably lube oil or fuels, which themselves may already contain other “additives.”

Effective concentrations of the five-group additive, or the blended additive, in conventional lube oils are believed to be 0.002– 20.0 LV-% five-group or blended additive (0.03 – 20 LV-% being typical) with 99.998 – 80 LV-% lube oil (99.97 – 80 LV-% being typical), for example. Effective concentrations of the five-group additive, or the blended additive, in combustion engine fuels are believed to be 0.002

– 5.0 LV-% five-group or blended additive (0.03 – 5 LV-% being typical) with 99.998 – 95 LV-% fuel (99.97 – 95 LV-% being typical), for example.

The inventor believes that many, if not all, polyalphaolefin compounds will be effective as “Group 2” in the preferred additives. Specific examples of polyalphaolefin compounds that have been effective in the below-described tests and examples are SYNTON™ PAOs (such as SYNTON-40™ and SYNTON-80™) available from Crompton Corporation/Great Lakes Corporation (Chemtura), and DURASYN™ PAO's available from BP Amoco.

The inventor envisions use of a wide range of concentrations of the five-group additive or the blended additive in lube oils, fuels, cutting oils, treatment oils, and that the more important issue is that components from the five groups be present in the lube or fuel, with or without other conventional or unconventional additive components.

EXAMPLE A

Additive:

40 LV-% C-400 Calcium Sulfonate

20 LV-% Polyalphaolefin

20 LV-% Castor Oil

2 LV-% Jojoba Oil

18 LV-% Canola Oil

Equaling 100 LV-% additive.

This formulation was blended by the methods described above, added to diesel fuel and to gasoline, and run in a variety of engines, as noted in the table below.

Tests 1 – 9 were performed under no-load conditions, with diesel fuel plus the additive (in a concentration of 1 ounce of additive in 12 gallons of conventional, commercial diesel fuel) compared to the same engine operating on only the diesel fuel. Tests 10 and 11 were performed under no-load conditions, with gasoline plus the additive (in a concentration of 1 ounce of additive in 18 gallons of conventional 87 octane, commercial gasoline) compared to the same engine operating with only the

gasoline. All emissions results were obtained by means of an analyzer in the vehicle tailpipe, such as a Ferret™, Sun™, or ECOM™ analyzer.

The results of this testing are shown below as percent change in emissions when going from the diesel-only or gasoline-only performances to the “diesel plus additive” or the “gasoline plus additive” performance, respectively.

In Tests 1, 3-9 (no data available for Test No. 2): when additive was included, O₂ increased by an average of 3%, while NO_x decreased by an average of approximately 18%, carbon monoxide decreased by an average of approximately 27 %, and carbon dioxide decreased by an average of approximately 8 %. When additive was included, NO₂ decreased by an average of approximately 19 %, and NO decreased by an average of approximately 17 %. Therefore, significant and surprising improvements in each of these emissions were seen in the diesel plus additive operations. In Test 10 and 11: when additive was included, hydrocarbon ppm emissions dropped by very large percentages, namely, approximately 100 % and 67 %, for an average of an 83.5 % decrease. Therefore, significant and surprising improvement in emissions was seen in the gasoline plus additive operations.

[illegible]

OVERVIEW OF EMISSIONS

Test Sequence A

VEHICLE	#1	JOHN DEERE		4850	Diesel
	#2	JOHN DEERE		4650	Diesel
	#3	JOHN DEERE		8300	Diesel
	#4	CASE STIEGER		9390	Diesel
	#5	FORD		1900	Diesel
	#6	NEW HOLLAND		LX665	Diesel
	#7	BOBCAT			Diesel
	#8	FREIGHTLINER		CAT	Diesel
	#9	DODGE RAM 1/2 TON			Diesel
	#10	96 JEEPCHEROKEE 4.0			Gas
	#11	2000 PONTIAC BONNEVILLE 3.8			Gas

DIESEL									AVERAGE
VEHICLE	#1	#3	#4	#5	#6	#7	#8	#9	
O2	+13%	+1%	+1%	+5%	+2%	+1.1%	+1%	+0.3%	3%
NOX	-20%	-14%	-15%	16%	-12%	-23%	-18%	-21%	-18.25%
CO	-20%	-21%	-18%	49%	-19%	-47%	-25%	-21%	-27.50%
CO2	-35%	0%	-3%	14%	-5%	-14%	-5%	-4.80%	-8.22%
NO2	-20%	-25%	-10%	-9%	-10%	-41%	-20%	19.30%	-19.28%
NO	-26%	-7%	-18%	17%	-12%	-18%	-18%	24.90%	-17.61%

GAS									AVERAGE
VEHICLE			#10	#11					
% DROP									
HC PPM			100%	67%					-83.50%

EXAMPLE B

Additive:

30 LV-% C-400-C Calcium Sulfonate (Crompton Corporation/Great Lakes Corporation (Chemtura))

30 LV-% Polyalphaolefin

20 LV-% Castor Oil

2 LV-% Jojoba Oil

18 LV-% Canola Oil

Equaling 100 LV-% additive.

Testing was done in a Cummins B Series Turbo Diesel, starting with conventional, commercial #2 diesel (Test No. 1), followed by: the same diesel combined with additive (Test No. 2), diesel with 2% bio-diesel additive and 1 ounce/10 gallons additive (Test No. 3), diesel with 5% bio-diesel additive and 1 ounce/10 gallons additive (Test No. 4), and the fuel of Test No. 4 with an additional 1 ounce of additive per 10 gallons of fuel.

Testing was done at various engine rpm with no load, and at various road speeds ("with load"). Emissions were reported as shown in the table below, in the form of percent change from the base test, that is, Test No. 1. The data shows substantial and surprising improvement in NO_x with the addition of additive and additive combined with bio-diesel. For example, NO_x decreased about 7 – 14 % at 2500 rpm, no load; 8 – 31% at 30 mph; 3 – 21% at 50 mph; and 4 – 8 % at 70 mph.

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Vehicle Dodge 2001 pick up
 VIN # 387KF23601G735111
 Engine Cummins B series Turbo Diesel
 Date of Testing 8/4/2004

Testing conditions

1. #2 diesel fuel
2. #2 diesel fuel with CA 40 treatment at 1 oz per 10 gallons of fuel
3. #2 diesel fuel + 2% bio-diesel with CA 40 treatment at 1 oz per 10 gallons of fuel
4. #2 diesel fuel + 5% bio-diesel with CA 40 treatment at 1 oz per 10 gallons of fuel
5. #4 fuel with additional 1 oz. CA 40 per 10 gallons of fuel

O₂= % CO= ppm NOX= ppm CO₂= %

Change = Difference from condition #1 / condition 1 data

800 RPM with No Load

Test Condition	O ₂	CO	NOX	CO ₂
1	18.5	286	282	1.8
Change	---	---	---	---
2	18.6	257	280	1.8
Change	+0.5%	-10%	-0.7%	0%
3	18.6	233	284	1.8
Change	+0.5%	-18.5%	+0.7%	0%
4	18.5	163	298	1.8
Change	0%	-43%	+5.6%	0%
5	18.6	206	289	1.8
Change	+0.5%	-30%	+2.4%	0%

2500 RPM with No Load

Test Condition	O ₂	CO	NOX	CO ₂
1	17.3	578	192	2.7
Change	---	---	---	---
2	17.3	751	167	2.7
Change	0%	+29%	-13%	0%
3	17.2	650	166	2.8
Change	-0.6%	+12%	-14%	+3.7%
4	17.1	627	172	2.9
Change	+1.1%	+8%	-10%	+7.4%
5	17.2	637	178	2.8
Change	-0.6%	-10%	-7%	+3.7%

30 MPH

Test Condition	O2	CO	NOX	CO2
1	15.5	460	587	4.0
Change	---	---	---	---
2	16.9	421	406	3.0
Change	+9%	-8.4%	-31%	-25%
3	16.8	378	420	3.1
Change	+9%	-17.8%	-28.%	-23%
4	16.9	377	505	3.7
Change	+9%	-18%	-14%	-7.5%
5	15.7	369	536	4
Change	-1%	-14%	-8.6%	0%

50 MPH

Test Condition	O2	CO	NOX	CO2
1	13.5	202	760	5.5
Change	---	---	---	---
2	15.3	312	597	4.2
Change	+13%	+54%	-21%	-24%
3	14.2	243	669	4.8
Change	+7%	+20%	-15%	-12.7%
4	13.3	284	636	4.8
Change	-1.4%	+40%	-16%	-14.5%
5	13.6	243	733	5.8
Change	+0.7%	+20%	-3.5%	+5.5%

70 MPH

Test Condition	O2	CO	NOX	CO2
1	13.3	213	457	5.6
Change	---	---	---	---
2	13.8	307	427	5.3
Change	+3.7%	+44%	-6.5%	-5.3%
3	13.4	305	421	5.6
Change	+5.7%	+43%	-7.9%	0%
4	12.5	196	439	6.2
Change	-6%	-7.9%	-3.9%	-10.7%
5	13.4	281	426	5.6
Change	+0.7%	+32%	6.8%	0%

Vehicle- Pont. Bonneville

EXAMPLE C

Additive:

30 LV-% C-400-c Calcium Sulfonate (Crompton Corporation/Great Lakes Corporation (Chemtura))

30 LV-% Polyalphaolefin

20 LV-% Castor Oil

2 LV-% Jojoba Oil

18 LV-% Canola Oil

Equaling 100 LV-% additive.

In this test, a gasoline vehicle was tested with load, at 75 mph. The vehicle was a 2001 Pontiac Bonneville with a 3800 engine (not turbo-charged). Test No. 1 was performed at 75 mph with conventional, commercial gasoline of 87 octane, and Test no. 2 was performed at 75 mph with the same gasoline plus 1 ounce of additive added per 10 gallons of the gasoline. The test results show substantial and surprising results in CO emissions and in NOx emissions. CO was reduced by over 15% and NOx was reduced by over 50%, as shown by the table below.

Test condition 1- 75 mph
2- 75 mph

without product

with 1 oz CA 40 per 10 gallons of gasoline

HC= ppm CO= %, CO2= %, O2= %, Nox= ppm

Test Condition	HC	CO	CO2	O2	NOx
1	1	.39	15.2	0	19
Change	--	---	----	--	--
2	1	.33	15.1	0	9
Change	0%	-15.3%	-0.6%	0%	-53%

****While specific baseline and experimental data was not formally collected, it appeared that spikes in HC and NOx during and shortly after rapid acceleration were substantially reduced.

In addition to the emissions improvements, the inventor has witnessed substantial improvements (reductions) in emissions of smoke and odor, and improvements in engine efficiency in terms of miles per gallon. Use of the additive resulted in approximately 25 % improvement in miles per gallon in many of the under-load tests above. In addition to NO_x reductions and efficiency improvement, the inventor believes that volatile organic compounds (VOC's) will be reduced as well with use of the additive or similar formulations.

The inventor believes that the combination of the preferred components has a synergistic, positive effect on emissions, smoke, odor, and engine efficiency. The inventor believes that PAO and soy methyl ester and/or canola oil may be important to smoke emissions, NO_x, and VOC's, and that there is a synergistic effect when said PAO and soy ester and/or canola oil are combined with the other components to greatly improve the performance of the invented additive.

The inventor believes that formulations such as additive and others within the broad scope of this invention will be very beneficial in a variety of applications. With use of the invented additive, decreased emissions are achieved, and increased engine efficiency translating into more miles per gallon. The inventor believes that automobile, bus, truck, airplane, train, heavy equipment, generators, etc. will benefit from the invented additive. Another example of a benefit of an embodiment of the invention is given below in Example D, wherein lawn mower performance is tested with and without an additive according to one embodiment of the invention.

EXAMPLE D

Testing was done using a 2005 Chevrolet Impala. The Federal Highway Fuel Efficiency Test protocol was used. Two tests (Baseline 1 and Baseline 2) were run and emission samples were taken using mid-grade gasoline and no additive. The tests were then repeated: Experiment 1 and Experiment 2 using the same fuel treated with an embodiment of the invented additive at a treatment rate of one fluid ounce of the

additive to ten gallons of gasoline, and Experiment 3 and Experiment 4 at a treatment rate of 1 ounce of the same additive per 15 gallons of gasoline. The data supports NOx reduction by using an embodiment of the invention. This data also suggests a tradeoff between NOx and CO emissions, wherein an extremely large decrease in NOx is achieved in Experiments 1 and 2, but with an increase in CO. Experiments 3 and 4 illustrate an excellent NOx decrease with an acceptable CO increase.

The composition of the additive was Calcium Sulfonate 40%, Jojoba Oil 2%, Castor Oil 20%, PAO 20%, Soy Methyl Ester 18%

Measurements were taken for Hydrocarbons, Carbon Monoxide, Oxides of Nitrogen, and Carbon Dioxide.

Mid grade fuel	HC	CO	NOx	CO2
Baseline 1(grams/mile)	0.019	0.415	0.031	335.480
Baseline2	0.011	0.325	0.020	323.642
Mean	0.015	0.370	0.026	329.561

1 oz/10 gal				
Fuel with Additive	HC	CO	NOx	CO2
Exp 1 (grams/mile)	0.013	0.843	0.008	345.001
Exp2	0.014	0.732	0.013	339.730
Mean	0.014	0.788	0.011	342.366
%change/ Baseline	-6.6%	+113%	-57.7%	+3.9%

1 oz/ 15gal				
Fuel with Additive	HC	CO	NOx	CO2
Exp 3	0.023	0.417	0.008	298.964
Exp 4	0.012	0.428	0.013	297.707
Mean	0.018	0.423	0.021	298.336
%Change/Baseline	+20%	+14.3%	-19.2%	-9.5%

EXAMPLE E

Additive in Lawn Mower Fuel

Ambient Temp: 50 degrees

Lawn Mower: Stanley riding lawn mower with Briggs & Stratton 21HP two cylinder engine

Procedures & Measurements:

Engine was warmed up and run until it burned up all the fuel in the tank and stopped.

The mower was then filled with three pints of Condition A fuel (below); engine was started and mower deck immediately engaged. RPM was held at 4400. A "Snap On" Tachometer was used to check the RPM. The engine was run until all of the three pints was burned and the engine stopped. A watch was set to measure the running time of this condition.

The mower was then filled with three pints of Condition B fuel (below); engine was started and mower deck immediately engaged. RPM was held at 4400. As above, a "Snap On" Tachometer was used to check the RPM. The engine was run until all of the three pints was burned and the engine stopped. As above, a watch was set to measure the running time of this condition.

Condition A fuel: 20 gallons gasoline with an octane rating of 87, plus one (1) ounce additive according to one embodiment of the invention:

Calcium Sulfonate: 30 LV%

Polyalphaolefin: 30 LV%

Castor Oil: 10 LV%

Jojoba Oil: 1 LV%

Soy Methyl Ester: 29 LV%

Equaling 100 LV-% additive.

Condition B used 100% gasoline with an octane rating of 87 (Not treated with any embodiment of the invented additive).

Condition A ran for 2910 seconds

Condition B ran for 2715 seconds

$2910 \text{ seconds} / 2715 \text{ seconds} = 1.0712$ approximately a 7% improvement in performance.

EXAMPLE F

Metal Conditioning Properties

Composition of Additive, according to one embodiment of the invention:

Calcium Sulfonate: 40 LV%

PAO: 20 LV%

Castor Oil: 20 LV%

Jojoba Oil: 1 LV%

Soy methyl ester: 19 LV%

Equaling 100 LV% Additive

Testing the muzzle velocity of a 180 grain 30 – 06 bullet when fired from a rifle as measured by a chronograph.

Condition A: hand-loaded cartridge (described above) was fired and velocity measured.

Condition B: identical to Condition A above except the cartridges were first put in the above-described Additive and the Additive with cartridges “soaking” therein were heated to 200 degrees F. After several minutes at 200 degrees F, the cartridges were removed, wiped clean, cooled, hand-loaded, and fired.

Results:

Condition A: 2768 feet per second.

Condition B: 2916 feet per second.

$2916 / 2768 = 1.0535$ -- approximately a 5.4 % increase in muzzle velocity.

EXAMPLE G

Mini-Masonry Chain Saw

Composition of Additive, according to one embodiment of the invention:

Calcium sulfonate: 40 LV%

PAO: 20 LV%

Castor Oil: 20%

Jobba Oil: 1 LV%

Soy Methyl Ester: 19 LV%

Equaling 100 LV % Additive

Method: Use a prototype masonry chain saw, temperature was measured at the hottest point of the saw (tip). Also, an observation was made regarding the speed of cutting.

Condition A: The saw was used to remove mortar between bricks on an existing wall. Water was used as a coolant.

Condition B: The saw was used to remove mortar between bricks on an existing wall, as in Condition A. Water, treated with PB 10 sulfur chlorinated water-soluble cutting oil, was used as a coolant.

Treatment rates: 1 oz per gallon of water

Condition C: The saw was used to remove mortar between bricks on an existing wall, as in Conditions A and B. Water, treated with the Condition B water soluble cutting oil and the Additive listed above, was used as a coolant. Treatment rates: 1 oz of the Additive was added to 4 oz PB 10. One ounce of the blend of Additive plus PB-10 was added per gallon of water.

Results:

Condition A: Tip Temperature = 161 degree F

Condition B: Tip Temperature = 130 degrees F

Condition C: Tip Temperature = 91 degrees F

Conclusions from Example F:

Water soluble oil as a coolant (Condition B) resulted in an average 31 degree F lower temperature compared to Condition A.

Additive plus Water Soluble Oil (Condition C) resulted in a temperature 70 degrees F lower than Condition A, and a temperature 39 degrees F lower than Condition B.

Other advantages included: In Conditions A and B (that is, without the Additive), the cutting debris stuck (impacted) to the chain and bar. Also, with the additive, the operator reported a significant increase in power and RPM, and that the rate of cutting appeared to double.

EXAMPLES – COLD PROPERTIES

In some cases, not all of the preferred five groups/components are necessary for the formulation. For example, there are cases where the additive is formulated for addition to one of the preferred five basic groups described above, for example, to soy methyl ester (“biodiesel”), that component may or may not be in the additive. For example, PAO, calcium sulfonate, castor oil, jojoba oil, and soy methyl ester may be added to biodiesel (soy methyl ester preferably with pour point depressant and/or other additives) or to a pour point depressant or other additive package that will subsequently be added to biodiesel. Also, the preferred groups minus the soy methyl ester (for example, PAO, calcium sulfonate, castor oil, jojoba oil) may be blended to formulate an additive that may be added to the biodiesel or to the pour point depressant or other additive package for biodiesel. Thus, when the additive is intended to be added to a larger amount of one of the preferred groups, that component need not necessarily be included in the original additive formulation. Note that this may apply to “biological diesels” other than soy methyl ester biodiesel, for example, canola-based diesel.

The inventor has found that an additive of PAO, calcium sulfonate, castor oil, and jojoba oil, is especially beneficial as a pour point suppression enhancer in biodiesel. This is especially important in view of the fact that conventional pour point depressants typically fail to reduce pour point to an acceptable level. The additive described in the test below, when combined with a conventional pour point depressant and then added to biodiesel, resulted in a pour point of less than -20 degrees F. The inventor has seen this beneficial effect when the invented additive is added to the pour point depressant (and then the combination added to the biodiesel), but, as of the date of filing this application, the inventor has not seen this beneficial effect when the

invented additive is added to the biodiesel directly (separately from the pour point depressant).

These pour point improvements are particularly important for regions wherein regulations will mandate that biodiesel be added to conventional diesel or other fuels. Pour point of the biodiesel during storage, handling, and blending into the conventional diesel or other fuels has been problematic in the past. Embodiments of the invention, therefore, may greatly assist in storage, handling and blending of the biodiesel, as well as of the resulting blends, in order to achieve the desired environmental and agricultural-economy benefits of biodiesel.

Preferred ranges of components for pour point depressant enhancement are: 10 – 60 LV-% Group 1, 0.1 – 50 LV-% Group 2; and 5.2 – 89.9 LV% plant oil or mixture of plant oils from Groups 3-5. In most embodiments, ranges are expected to be: 25 – 45 LV% Group 1 component(s); 15 – 40 LV% Group 2 component(s); 10 – 20 LV% Group 3 component(s); 1-5 LV% Group 4 component(s); and 5 – 45 LV% Group 5 component(s). Group 5 may be excluded from the formula for the additive, for example, when the additive is later added to soy methyl ester biodiesel (see earlier comments relating to Group 5 being left out of additive for later addition to a group five-based diesel)). For pour point depressant enhancement, a pour point depressant is added to the other 4 – 5 groups (Groups 1-4, or Groups 1-5), in an amount of approximately 1 – 10 LV% of the additive prior to addition to the bulk biodiesel.

As discussed earlier for other applications, the blending process is best done by adding Group 4 to the Group 1 component(s), and blending these two components/groups very well before adding any other groups. After blending the first two groups, the Group 2 and 3 component(s) may be added, (optionally) the Group 5 component(s), and the pour point depressant may be added. High-shear, extended blending (for example, 4 hours or greater), and/or heating (100 – 140 degrees F) may be needed to properly blend the components.

The preferred pour point enhancement additive, which comprises Groups 1 – 4, optionally Group 5, and preferably a plant-oil-based pour point depressant (Rho-Max 10 – 310, currently available from RHOMAX in Montreal, and reported to be a rapeseed oil derivative being the one preferred by the inventor), has been found to be

effective in lowering the pour point of biodiesel lower than with the same pour point depressant alone. Said additive should be added to the biodiesel (soy methyl ester biodiesel or other biological diesels or blends thereof) in amounts ranging from about 1 fluid ounce to 10 gallons to 1 fluid ounce to 2 gallons (0.08 – 0.4 LV-%).

EXAMPLE H

Cold Temp Properties

The “bulk” fuel in this example is bulk soy methyl ester herein, and is called “Biodiesel” and “B-100” (meaning 100% soy methyl ester).

Two samples were used:

Sample A: B-100

Sample B: B-100 plus an embodiment of the invented additive plus conventional pour point depressant (Rho-Max 10 – 310). The embodiment of the invented additive consisted of (LV-%):

44.4 %	Calcium Sulfonate
16.7%	Castor Oil
37.8%	Poly Alpha Olefin (PAO)
<u>1.1 %</u>	<u>Jojoba Oil</u>

Totaling 100 LV-%

Pour point depressant was blended with the above additive, resulting in:

40 %	Calcium Sulfonate
15%	Castor Oil
34%	Poly Alpha Olefin (PAO)
10%	Pour point depressant (RHO-Max 10 – 310)
<u>1 %</u>	<u>Jojoba Oil</u>

Totaling 100 LV-%

This blend of the additive plus pour point depressant was then added to B-100 at a rate of one ounce per five gallons of B-100, and heated to 104 degrees Fahrenheit for a period of five hours.

Method: Samples A and B were put in similar containers and brought to lower temperatures. Viscosity and pourability were visually checked.

Results: Both Samples A and B were observed to have similar viscosity and both samples poured at similar rates from 80 to 30 degrees F.

Sample A became cloudy at about 25 degrees F and turned to a solid at 20 degrees F.

Sample B showed some clouding at -10 degrees F, but continued to pour well at -20 degrees F (that is, poured in a manner similar to Sample A when Sample A was at 70 degrees F). Pourability of Sample B remained at this level with no observable change for a period of two weeks. The sample was then diluted with 50% soy methyl ester (that is, 50 LV% more B-100 was added), and identical results were noted. Therefore, the inventor believes the additive to be highly effective as an enhancer for pour point depressant over a wide range of concentrations.

EXAMPLE I

Cold Temp Properties

The inventor has found that, when embodiments of the invented additive are blended with a conventional pour point depressant and then added to "B-20" (which is common terminology for a bulk fuel of 80 LV-% conventional diesel fuel plus 20 LV-% Biodiesel (soy methyl ester)), the soy methyl ester does not separate from the conventional diesel fuel at -20 degrees F. This surprising result may be due to the invented additive being a bonding agent between the esters and the hydrocarbons. This benefit may extend to very low temperature, such as -40 degrees F, wherein the additive may act as an anti-gel/anti-separation agent for diesel fuels.

EXAMPLE J

Cold Temp Properties vs. Concentration of Additive in Biodiesel

Several additives were blended in the following ranges and tested in Biodiesel:

C-400-C	40%
PAO	20 – 30%
Castor Oil	10 - 15%
Sulfated Castor Oil (“75% sulfated”)	5%
Jojoba or similar wax oil/ester	2%
SME	16 - 20%
RHO-MAX--310	2 - 3%

On average, one fluid ounce of the additive added to 10 gallons B-100 biodiesel resulting in the treated biodiesel being liquid at 20 - 25 degrees F.

On average, one fluid ounce of the additive added to 5 gallons B-100 biodiesel resulting in the treated biodiesel being liquid at 10 degrees F.

On average, one fluid ounce of the additive added to 2 gallons B-100 biodiesel resulting in the treated biodiesel being liquid at minus 20 degrees F.

EXAMPLES OF TARGETED FORMULAS

The additive formula may be adapted to target specific applications.

1. For example, it is envisioned that an excellent formula for miles per gallon improvement of gasoline or diesel, wherein NO_x reduction is not a concern, may be:

C-400-C	40%
PAO	Optional
Castor Oil	20%
Sulfated Castor Oil (“75% sulfated”)	5%
Jojoba	
or similar waxy oil/ester	2%
SME	33%

(all in LV-% of total additive, to be added to a fuel)

2. It is envisioned that, for a miles per gallon enhancer where visible smoke and NO_x are of greatest concern, an especially-effective formula may be:

C-400-C	30%
PAO	30%
Castor Oil	10%
Sulfated Castor Oil	5%
Jojoba	
or similar waxy oil/ester	2%
SME	23%

(all in LV-% of total additive, to be added to a fuel)

3. It is envisioned that, when pour point depression is of greatest interest, an especially-effective formula may be:

C-400-C	40%
PAO	20%
Castor Oil	15%
Sulfated Castor Oil	5%
Jojoba	
or similar waxy oil/ester	2%
SME	16%

Conventional Pour Point Depressant

(such as RHO-MAX family of depressants
as discussed earlier)

2%

(all in LV-% of total additive, to be added to a biodiesel or biodiesel-containing fuel)

4. It is envisioned that, for metal conditioning or cutting fluid, an especially-effective formula may be:

C-400-C	40%
PAO	20%
Castor Oil	15%
Sulfated Castor Oil	5%
Jojoba	
or similar waxy oil/ester	2%
SME	18%

(all in LV-% of total additive, for addition to a lube oil for metal lubrication or a cutting fluid for metal cutting/fabrication).

In some embodiments, the invented additive composition for motor fuels, metal lubricants, or cutting fluids may be described as comprising a polyalphaolefin (PAO) component; a calcium source; and at least one plant oil or mixture of plant oils; wherein the PAO component is present in 0.1 – 50 LV%, the calcium source is present in 10 – 60 LV%, and said at least one plant oil or mixture of plant oils is present as 0.2 – 89.9 LV% of the additive.

In some embodiments, the invented additive composition for motor fuels, metal lubricants, or cutting fluids may be described as comprising:

- 10 – 60 LV-% overbased calcium sulfonate;
- 0.1 – 50 LV-% polyalphaolefin,
- 0.1 – 40 LV-% castor-derived oil selected from the group consisting of castor oil and sulfated castor oil;
- 0.1 – 30 LV-% jojoba oil; and
- 5 – 45 LV-% plant oil selected from the group consisting of soy oil/ester, canola oil/ester, palm oil, coconut, and sunflower oil;

wherein said overbased calcium sulfonate, polyalphaolefin, castor-derived oil, jojoba oil, and plant oil are blended together to form 100 LV% of said additive.

In some embodiments, the invented composition for motor fuels, metal lubricants, or cutting fluids may be described as comprising:
an additive comprising a polyalphaolefin (PAO) component; a calcium source; and at least one plant oil or mixture of plant oils; wherein the PAO component is present as 15 - 40 LV%, the calcium source is present in 25 - 45 LV%, and said at least one plant oil or mixture of plant oils is present in 15 - 60 LV% of the additive; and wherein said additive is blended with said motor fuel in a proportion of 0.002 - 5.0 LV % additive and 99.998 - 95 LV-% fuel.

In some embodiments, an invented pour point depression enhancement composition for biodiesel fuel may be described as comprising:

an additive comprising a polyalphaolefin (PAO) component; a calcium source; at least one plant oil or mixture of plant oils; and

a diesel pour point depressant;

wherein the PAO component is present in 15 - 40 LV%, the calcium source is present in 25 - 45 LV%, said at least one plant oil or mixture of plant oils is present in 15 - 60 % LV% of the additive; and

wherein said pour point depressant is blended into said additive ranging from 99 parts of said additive and 1 part said pour point depressant to 90 parts said additive and 10 parts said pour point depressant, said parts being measured by liquid volume.

Embodiments of invented methods may be described as a method of lowering pour point in a biodiesel comprising: blending an additive into biodiesel comprising: depression enhancement composition as in Claim 25, wherein 100 LV-% of said additive comprises 15 - 40 LV% polyalphaolefin, 25 - 45 LV% overbased calcium sulfonate, and 15 - 60 % LV% at least one plant oil or mixture of plant oils.

Although this invention has been described above with reference to particular means, materials and embodiments, it is to be understood that the invention is not limited to these disclosed particulars, but extends instead to all equivalents within the broad scope the following claims.

CLAIMS

I claim:

1. A pour point depression enhancement composition for biodiesel fuel, the composition comprising:
 - an additive comprising:
 - a polyalphaolefin (PAO) component;
 - a calcium source;
 - at least one plant oil or mixture of plant oils; and
 - a diesel pour point depressant;wherein the PAO component is present as 15 - 40 LV%, the calcium source is present as 25 - 45 LV%, said at least one plant oil or mixture of plant oils is present as 15 - 60 % LV% of the additive; and
said pour point depressant is blended into said additive ranging from 99 parts of said additive and 1 part said pour point depressant to 90 parts said additive and 10 parts said pour point depressant, said parts being measured by liquid volume.
2. A pour point depression enhancement composition as in Claim 1, wherein said pour point depressant comprises a rapeseed oil or derivative of rapeseed oil.
 3. A pour point depression enhancement composition as in Claim 1, wherein said pour point depressant is a rapeseed-based pour point depressant.
 4. A method of lowering pour point in a biodiesel comprising:
 - blending an additive into biodiesel comprising: depression enhancement composition as in Claim 25, wherein 100 LV-% of said additive comprises 15 - 40 LV% polyalphaolefin, 25 - 45 LV% overbased calcium sulfonate, and 15 - 60 % LV% at least one plant oil or mixture of plant oils.

5. A method as in Claim 4, further adding a rapeseed pour point depressant to said additive prior to blending the additive into the biodiesel in concentrations ranging from 99 parts of said additive and 1 part said pour point depressant to 90 parts said additive and 10 parts said pour point depressant, said parts being measured by liquid volume.
6. A method as in Claim 5, wherein the additive plus rapeseed pour point depressant is blended into said biodiesel in concentrations of 1 fluid ounce additive-plus-pour-point-depressant to 2 gallons biodiesel, whereby the biodiesel treated with the additive-plus-pour-point-depressant remains liquid at minus 20 degrees F.
7. A method as in Claim 5, wherein the additive plus rapeseed pour point depressant is blended into said biodiesel in concentrations of 1 fluid ounce additive-plus-pour-point-depressant to 5 gallons biodiesel, whereby the biodiesel treated with the additive-plus-pour-point-depressant remains liquid at 10 degrees F.
8. An additive composition for motor fuels, metal lubricants, or cutting fluids, the additive comprising:
 - a polyalphaolefin (PAO) component;
 - a calcium source; and
 - at least one plant oil or mixture of plant oils;wherein the PAO component is present in 0.1 – 50 LV%, the calcium source present in 10 – 60 LV%, and said at least one plant oil or mixture of plant oils is present as 0.2 – 89.9 LV% of the additive.
9. An additive according to Claim 8, wherein the calcium source is calcium sulfonate.
10. An additive according to Claim 8, wherein the calcium source is overbased calcium sulfonate.

11. An additive according to Claim 8, wherein the plant oil is selected from the group consisting of castor oil, jojoba oil, rape seed (canola) oil, palm oil, coconut, sunflower oil, soybean oil, and mixtures thereof.
12. An additive according to Claim 8, wherein the plant oil comprises castor oil.
13. An additive according to Claim 8, wherein the plant oil comprises jojoba oil.
14. An additive according to Claim 8, wherein the plant oil comprises soy methyl ester.
15. An additive according to Claim 8, wherein the plant oil comprises soy ethyl ester.
16. An additive according to Claim 8, wherein the plant oil is canola oil.
17. An additive according to Claim 8, wherein the plant oil is a methyl or ethyl ester.
18. An additive composition for motor fuels, metal lubricants, or cutting fluids, the additive comprising:
 - 10 – 60 LV-% overbased calcium sulfonate;
 - 0.1 – 50 LV-% polyalphaolefin,
 - 0.1 – 40 LV-% castor-derived oil selected from the group consisting of castor oil and sulfated castor oil;
 - 0.1 – 30 LV-% jojoba oil; and
 - 5 – 45 LV-% plant oil selected from the group consisting of soy oil/ester, canola oil/ester, palm oil, coconut, and sunflower oil;wherein said overbased calcium sulfonate, polyalphaolefin, castor-derived oil, jojoba oil, and plant oil are blended together to form 100 LV% of said additive.

19. An additive as in Claim 18, wherein said overbased calcium sulfonate is 25 – 45 LV%, said polyalphaolefin is 15 – 40 LV%, said castor-derived oil is 10 – 20 LV%, said jojoba is 1-5 LV%, and said plant oil is 5 – 45 LV% of said additive.
20. A composition for motor fuels, metal lubricants, or cutting fluids, comprising:
 - an additive comprising:
 - a polyalphaolefin (PAO) component;
 - a calcium source; and
 - at least one plant oil or mixture of plant oils;
 - wherein the PAO component is present as 15 - 40 LV%, the calcium source is present in 25 - 45 LV%, and said at least one plant oil or mixture of plant oils is present in 15 – 60 LV% of the additive.
 - wherein said additive is blended with said motor fuel in a proportion of 0.002 – 5.0 LV % additive and 99.998 – 95 LV-% fuel.
21. A composition according to Claim 20, wherein said motor fuel is gasoline.
22. A composition according to Claim 20, wherein said motor fuel is petroleum diesel.
23. A composition according to Claim 20, wherein said motor fuel comprises soy methyl ester or soy ethyl ester biodiesel.
24. A composition according to Claim 20, wherein the calcium source is calcium sulfonate.
25. A composition according to Claim 20, wherein the plant oil is selected from the group consisting of castor oil, sulfonated castor oil, jojoba oil, rape seed (canola) oil, palm oil, coconut oil, sunflower oil, soybean oil, and mixtures thereof.

26. A composition according to Claim 20, wherein the plant oil comprises castor oil.
27. A composition according to Claim 20, wherein the plant oil comprises jojoba oil.
28. A composition according to Claim 20, wherein the plant oil comprises soy methyl ester.
29. An additive according to Claim 20, wherein the plant oil comprises soy ethyl ester.
30. An additive according to Claim 20, wherein the plant oil is a methyl or ethyl ester.