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FUEL OIL COMPOSITION

Raymond Gay and Emanuel Siganos, Notre-Dame-de-Gravenchon, France, assignors to Esso Research and Engineering Company, a corporation of Delaware

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The present invention relates to an improved fuel oil.

The words "fuel oil" are herein defined as a normally liquid hydrocarbon for example a petroleum distillate boiling above about 400° F. and including light fuel oils, gas oils, used as fuels for diesel engines, and heavy oils used in furnaces.

To increase the power output of an internal combustion engine, for example, a diesel engine, it is common practice to inject an increased quantity of fuel into the combustion chamber. However, in the case of diesel engines, when the quantity of injected fuel exceeds certain critical limits, then a copious liberation of smoke occurs in the exhaust gases due to incomplete combustion of the fuel. Further, the increased power output which is obtained as a result of an increased injection of fuel is not directly proportional to the amount of fuel used. Consequently the specific consumption of the engine increases with increasing fuel injection.

It has previously been proposed to add oil-soluble lead salts to fuel oil particularly diesel oils to improve the anti-corrosive properties of the oils. Whilst these additives lessen the anti-corrosive properties of fuel oils having a high sulphur content, they have no effect on the combustion properties of the oil particularly the tendency to form smoke.

It has now been discovered that it is possible to substantially improve the properties of the fuel oil, particularly the tendency to smoke by adding to the fuel oil a small proportion of a composition comprising an ashless detergent and the oil-soluble salt of a metal of group IV of the periodic table.

Lead salts are particularly preferred in the composition of the present invention. A mixture of the salts of the aforesaid metals may be used instead of the salt of one metal.

The oil-soluble metallic salts used in accordance with the present invention may be salts of fatty acids, for example, palmitic, stearic, erucic, oleic or ricinoleic acids, or salts of naphthenic abietic or sulphonic acids, or salts of any organic acid having more than 6 carbon atoms per molecule.

Any ashless detergent may be used in the present invention. It is preferred to use polymeric or copolymeric products containing an active detergent group, which may be obtained by incorporating in the polymeric or copolymeric chain sulphurised or phosphosulphurised groups, or nitrogen- or oxygen-containing groups, and which may of may not contain alkoxy groups.

Suitable detergents may be built up of copolymerisable unsaturated mono- and/or dibasic acids, or alkoxy derivatives thereof, including ester derivatives. Such products may be derived from C_4 to C_{20} alcohols and maleic and/or fumaric acids, or mixtures of said esters including alkoxylated partial esters, and vinyl esters of C_2 to C_6 monobasic acids, e.g., vinyl acetate.

Other copolymeric compounds may be derived from alkyl-substituted acrylic acid and aliphatic alcohols, including amino alcohols.

Condensation products of an oil-soluble sulphonate and

an alkyl polyamine such as ethylene diamine and triethylamine may be also used as the ashless detergent in the composition of the present invention.

A mixture of the above detergents may be used instead of any particular detergent.

The total additive composition incorporated in the oils according to the present invention preferably comprises from 25 to 90% by weight of the oil-soluble salt of the said group IV metal and from 10 to 75% by weight of the said ashless detergent, and more particularly from 40 to 60% by weight of the oil-soluble salt of the group IV metal and from 60 to 40% by weight of the ashless detergent, the percentage being based on the total additive compound.

The total quantity of detergent additive added to the fuel oil is preferably within the range of 0.001 to 0.5% and more particularly 0.005 to 0.1% by weight of fuel oil.

Fuel oil compositions prepared according to the present invention were tested on a General Motors diesel engine (G.M. 371) having the following characteristics:

No. of cylinders		3
Bore (4¼")	mm.	108
Stroke (5")	mm.	127
Cylinder capacity (212 cu. ins.)	ccs.	3490
Temperature of water	° C.	80
Temperature of oil	° C.	107

The smoke measurements at the exhaust were carried out with the smoke indicator known by the name of "Von Brand Smoke-Meter." This apparatus makes it possible to measure the smoke in the exhaust gases by causing them to pass through a paper screen which unwinds continuously at constant speed. The intensity of the spot obtained is measured by interpolation between two standards (one white, the other black); this determination is effected by comparison with a datum scale, or more accurately by measuring the percentage of light reflected by means of a photo-reflectometer.

EXAMPLE I

A gas oil containing an additive in accordance with the present invention was used in a diesel engine of the type described above. The gas oil used had the following characteristics:

Density at 15° C	0.868
Engler Viscosity at 20° C	1.48
Sulphur, percent	1.08
Cetane index	43

The additive contained 50% by weight of an ashless detergent "A" and was added to the gas oil in quantities such that 1 kilogram of the oil contained 0.0005 gram atoms of metal.

The ashless detergent "A" was prepared as follows. Maleic anhydride was reacted with a C_9 Oxo alcohol at 70° C., in the presence of a boron trifluoride/ether complex. One mole of the monoester obtained was then condensed with 3 moles of ethylene oxide. 8% by weight of the ethoxylated monoester was then copolymerised with 37% by weight of a C_9 Oxo alcohol maleofumarate, 35% by weight of a C_{16-17} Oxo alcohol maleofumarate, and 20% by weight of vinyl acetate, at 70–75° C., for 5 hours in the presence of benzoyl peroxide as catalyst.

The smoke index (I); consumption in litres per hour (C); specific consumption in gms./H.P./hour (Cs) and mean temperature of exhaust gases (t) were measured and the results obtained are summarised in Table I.

It will be seen from Table I that the gain in power,

at a specific smoke index, resulting from the incorporation of an oil-soluble salt of a group IV metal plus an ashless dispersant is substantially greater than without the dispersant, and corresponding improvements are obtained in specific consumption (taken at a given smoke index).

The variations in the output of a diesel engine of the type previously described and the specific consumption of such an engine were investigated as a function of the smoke index when the engine was supplied with a fuel oil with or without the addition of additive compositions according to the present invention.

The gas oil used had the following characteristics.

Density at 15° C	0.857
Engler Viscosity at 20° C	1.43
Sulphur, percent	0.5
Cetane number	42

The additive composition comprised 60% by weight of an ashless detergent and lead naphthenate and was added to the gas oil in quantities such that 1 kmg. of the gas oil contained 0.001 gm. atoms of lead.

The results of the experiment are summarised in Table II.

From the results it can be seen that for a given smoke index, for example, 6, the addition of the additive composition of the present invention to the gas oil results in:

(1) A gain in output of from 6% to 12%.

(2) A decrease in specific consumption of from 2 to 3%.

Table I

Engine output regulated to		Datum fuel oil	Lead oleate+ dispersant A	Tin naphthenate+ dispersant A	Titanium sulphonate (without dispersant A)	Thorium sulphonate (without dispersant A)
42 CV	I	3.5	2.5	3	2.5	3.5
	C	10.14	10.04	10.01	10.07	10.14
	Cs	207.60	205.60	204.90	206	207.60
	t	242	237	237	237	241
45 CV	I	3.5	2.5	3	2.5	3.5
	C	10.82	10.76	10.69	10.69	10.81
	Cs	206.70	205.50	204.30	204.30	206.60
	t	258	256	254	255	257
48 CV	I	4	3	3	3.5	3.5
	C	11.52	11.38	11.30	11.48	11.40
	Cs	206.40	203.80	202.45	204.10	204.25
	t	273	268	269	269	272
51 CV	I	4.5	3.5	3.5	4	4
	C	12.24	12.02	11.86	12.09	12.10
	Cs	206.40	202.70	200	203.80	204
	t	288	285	285	286	287
54 CV	I	5	4	4	4.5	4.5
	C	12.7	12.50	12.44	12.55	12.58
	Cs	202.60	199.05	198.10	200	200.40
	t	296	293	291	292	296
55.8	I	5.5	4.5	4.5	5	5
	C	13.13	12.91	12.92	13	13.01
	Cs	202.30	198.90	198.90	200.20	200.30
	t	307	304	303	305	307

Results deduced from this table:

	Gain in power at 3.5 smoke index	Decrease of specific consumption at 3.5 smoke index
Titanium	6½	2.3
Tin+Dispersant	13,13	6.7
Thorium	6.5, 6½	2.1
Lead+Dispersant	13,13	3.7

Table II

Smoke Index	Gas-oil	Engine Supplied With— Gas oil+lead naphthenate+ Dispersant A (Example I)	Monosulphate of ethylene diamine	Sulphonate of ethylene diamine	Sulphonate of triethanolamine	Copolymer of methacrylate alcohol and amino alcohol
I. Engine Power in H.P.						
5	38	48	42	42	42	42
5.5	42	52	50	46	48	47
6	48	55	53	51	52	52
6.5	51	58	57	54	55	54
7	54	60	59	55	56	58
8	60	65	63	61	62	62
II. Specific Consumption of Engine in grammes/H.P./hour.						
5	222	215	217	218	218	219
5.5	219	213	214	215	215	216
6	215	210	211	213	213	213
6.5	213	208	208	211	207	210
7	210	205	205	209	207	207
8	205	199	199	204	202	202

What is claimed is:

1. A fuel oil containing from 0.001 to 0.5% by weight of a mixture of an oil soluble salt of a metal of group IV and from 10 to 75% by weight of an oil soluble ashless copolymer produced by copolymerizing 8 parts of an ethoxylated monoester of C_9 Oxo maleate with 37 parts of C_9 Oxo maleofumarate, 35 parts of C_{16}–C_{17} Oxo maleofumarate and 20 parts of vinyl acetate.

2. A fuel oil composition as defined in claim 1 wherein said fuel oil is a petroleum distillate boiling above 400° F.

3. A fuel oil composition as defined in claim 1 wherein said group IV metal is lead.

4. A fuel oil composition as defined in claim 1 wherein said group IV metal is tin.

5. A fuel oil composition as defined in claim 1 wherein said oil soluble salt has more than 6 carbon atoms per molecule.

6. A fuel oil containing from 0.005 to 0.1% by weight of a mixture of from 40–60% by weight of tin naphthenate and from 40–60% by weight of an oil soluble ashless copolymer produced by copolymerizing 8 parts of an ethoxylated monoester of C_9 Oxo maleate with 37 parts of C_9 Oxo maleofumarate, 35 parts of C_{16}–C_{17} Oxo maleofumarate and 20 parts of vinyl acetate.

7. A fuel oil containing from 0.005 to 0.1% by weight of a mixture of from 40–60% by weight of lead oleate and from 40–60% by weight of an oil soluble ashless copolymer produced by copolymerizing 8 parts of an ethoxylated monoester of C_9 Oxo maleate with 37 parts of C_9 Oxo maleofumarate, 35 parts of C_{16}–C_{17} Oxo maleofumarate and 20 parts of vinyl acetate.

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