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Fuel composition.

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A fuel composition suitable for use in spark ignition engines, comprises a hydrocarbon fuel and a dialkyl carbonate having a boiling point of not more than 150°C. Preferred dialkyl carbonates are dimethyl carbonate and diethyl carbonate. The hydrocarbon fuel may be a leaded or unleaded gasoline.

FUEL COMPOSITION

This invention relates to a fuel composition suitable for use in spark ignition internal combustion engines.

Certain oxygenated organic compounds have been known to be potentially suitable as fuels for internal combustion engines for many years. Interest in such components as fuels declined when crude oil became cheap and plentiful, but has revived in recent years. The most commonly proposed compounds are alcohols e.g. methanol, ethanol or tertiary butyl alcohol and ethers e.g. methyl tertiary butyl ether.

Oxygenated organic compounds can be used as fuels per se, but normally they are proposed for use in admixture with conventional hydrocarbon fuels, thereby avoiding the need for any major modification of engines using the fuels. For use in admixture with conventional fuels the oxygenated organic compounds should have a number of particular physical and chemical characteristics such as total miscibility, suitable volatility, and, preferably, low water solubility. One of the most important characteristics for spark ignition engine fuels, however, is the blending octane value, both in respect of the Research Octane Number (RON) and the Motor Octane Number (MON). It is desirable that the oxygenated compounds used should have blending octane values that enhance rather than depress the Octane Numbers of the neat hydrocarbon fuel.

According to the present invention a fuel composition suitable for use in internal combustion engines comprises a gasoline and a dialkyl carbonate having a boiling point of not more than 150°C.

The alkyl groups may be the same or different and, to keep the boiling point at not more than 150°C, the alkyl groups may be methyl, ethyl or isopropyl. Preferably the dialkyl carbonate boils below 130°C. Preferred compounds are dimethyl carbonate which boils at 91°C and diethyl carbonate which boils at 126°C.

The proportion of dialkyl carbonate may be from 0.1 to 50% by volume, preferably from 5 to 25% by volume of the fuel composition.

Dialkyl carbonates may be produced by any of the known methods, such as for example by reacting an alkanol with carbon monoxide in the presence of a catalyst, e.g. palladium or platinum salts or a copper complex catalyst. It may thus be produced from relatively cheap and abundant reactants.

Preferably the gasoline has, before the addition of the dialkyl carbonate, a RON of from 85 to 105, more preferably from 90 to 98 and a MON of from 75 to 95, more preferably from 80 to 88.

The gasoline may contain the following proportions of olefins, aromatics and saturates;

Aromatics	20 to 60	% volume
Saturates	20 to 65	% volume
Olefins	0 to 30	% volume

The fuel may contain a lead alkyl anti-knock agent in an amount up to 0.45g Pb/l, more preferably up to 0.15g Pb/l. Other known fuel components may be included in the compositions e.g. a scavenger, other oxygenated compounds and anti-icing or other known additives.

The dialkyl carbonates have been tested in a range of gasolines, both aromatic and olefinic and both leaded and unleaded. Blending octane values for the dialkyl carbonates have been found to range from 106 to 112 RON and 96 to 106 MON, when added to gasoline at a concentration of 10% by volume.

The invention is illustrated by the following examples:

Example 1

Dimethyl carbonate was admixed with two gasolines, one an aromatic basestock and the other an olefinic basestock. The aromatic basestock comprised 47.3% by volume aromatics and 52.7% by volume saturates. The olefinic basestock comprised 31.0% by volume

aromatics, 53.8% by volume saturates and 15.2% by volume olefins. The Research and Motor Octane Numbers of the gasolines and the blends containing dimethyl carbonate were determined in a CFR engine. The Blending Octane Values (B.O.V.) were also calculated from the measured
5 RONs and MONs of the gasolines and the dimethyl carbonate/gasoline blends, using the formula;

$$\text{BOV} = \frac{\text{Blend Octane No} - (\text{Basestock Octane No} \times \text{gasoline vol fraction})}{\text{volume fraction of the dialkyl carbonate}}$$

10 where, the volume fraction = $\frac{\text{percentage volume of the component}}{100}$

The dimethyl carbonate was a commercial material supplied by the Aldrich Chemical Company. It had a boiling point of 91°C.

15 Inspection data on the aromatic gasoline and the corresponding gasoline/dimethyl carbonate blend are shown in Table 1. It will be seen that the addition of the dimethyl carbonate did not significantly affect the distillation characteristics. The water tolerance was assessed according to the test method IP 98/44 Tentative.

20 The method measures the amount of water which can be added to a motor fuel, which may consist of a blend of hydrocarbons with a water-soluble constituent such as alcohol, without causing separation into two phases, at a specified temperature. The method comprises cooling a sample of the blend to about 4°C and adding water until separation
25 into two layers occurs. The sample is, then warmed until miscibility occurs and then cooled slowly. The temperature at which the first signs of cloudiness occurs is recorded. The test is repeated with different volumes of water and the water tolerance at specified temperatures obtained from a graph of volume of water against
30 temperature of immiscibility.

The results given in Table 1 show that the water tolerance of the dimethyl carbonate/gasoline blend was satisfactory.

Table 1

	Gasoline (aromatic)	Gasoline/ Dimethyl Carbonate blend
ASTM Distillation °C		
IBP	37.0	37.0
2% vol. recovered at	43.5	44.0
5% vol. " "	48.5	48.5
10% vol. " "	53.5	53.0
20% vol. " "	62.0	60.0
30% vol. " "	70.0	67.0
40% vol. " "	80.0	75.0
50% vol. " "	92.0	84.0
60% vol. " "	106.0	95.0
70% vol. " "	119.5	111.0
80% vol. " "	131.5	127.5
90% vol. " "	145.0	145.5
FBP	168.0	166.0
Recovery % vol.	97.0	98.0
Residue " "	1.0	1.0
Loss " "	2.0	1.0
Recovered at 70°C %vol	30.0	34.0
Recovered at 100°C "	56.0	63.5
Reid Vapour Press. lbs/in ² (KNm ⁻²)	7.5 (51.7)	7.8 (53.8)
Water tolerance at -20°C % vol	-	0.04
0°C	-	0.09
20°C	-	0.15

The CFR engine results on both gasolines are shown in Table 2 below:

Table 2

5	<u>Blend Composition % vol.</u>				
	Gasoline 1 (Aromatic)	100	-	90	-
	Gasoline 2 (Olefinic)	-	100	-	90
	Dimethyl Carbonate	-	-	10	10
10	<u>CFR Ratings</u>				
	RON - clear	93.7	92.7	95.2	94.5
	MON - clear	84.0	83.0	85.5	84.5
15	<u>Blending Octane Values</u>				
	RON	-	-	108.7	110.7
	RON - average	-	-	109.7	
	MON	-	-	99.0	98.0
20	MON - average	-	-	98.5	

Table 2 shows that the inclusion of 10% vol of dimethyl carbonate gives a significant increase in both the RON and the MON. This is because of intrinsically high RON and MON of the dimethyl carbonate itself.

Example 2

10% by volume diethyl carbonate was admixed with a gasoline from an aromatic base-stock comprising 40.2% by volume aromatics and 59.8% by volume saturates. The diethyl carbonate was a commercial product supplied by Aldrich Chemical Company. The boiling point of the diethyl carbonate was 125°C.

Inspection data on the gasoline and the gasoline/diethyl carbonate blend are shown in Table 3. It will be seen that the addition of the diethyl carbonate did not significantly affect the distillation characteristics.

The water tolerance at 20°C, determined as described in Example 1, was 0.03% volume which is satisfactory.

A test was carried out to simulate adverse tank storage conditions. 5 cm³ of mains tap water were added to 100 cm³ of the gasoline/diethyl carbonate blend and the mixture was agitated for about 30 seconds. The mixture was allowed to stand for one week and a sample of the bottom layer, i.e. the water phase, was subjected to IR analysis to determine the amount of diethyl carbonate in this layer. The water phase contained less than 1% by volume of diethyl carbonate.

The Blending Octane Values for the diethyl carbonate were calculated from the Research and Motor Octane Numbers determined in a CFR engine. The CFR engine results are given in Table 4.

Table 3

	Gasoline	Gasoline/ Dimethyl Carbonate blend
ASTM Distillation °C		
IBP	45.0	44.0
2% recovered at	53.0	52.0
5% " "	59.0	59.0
10% " "	64.0	66.0
20% " "	73.0	75.0
30% " "	82.0	84.0
40% " "	91.0	94.0
50% " "	102.0	105.0
60% " "	113.0	114.0
70% " "	125.0	123.0
80% " "	137.0	131.0
90% " "	151.0	145.0
FBP	183.0	181.0
Recovery (% vol)	97.0	98.0
Residue " "	1.0	1.0
Loss " "	2.0	1.0
Recovered at 70°C%vol	16.5	14.5
Recovered at 100°C "	47.5	45.5
Reid Vapour Press. lbs/in ² (KN/m ²)	6.4 (44)	6.1 (42)

Table 4

<u>Blend Compositions (%vol)</u>		
Gasoline (aromatic)	100	90
Diethyl carbonate	-	10
<u>CFR Ratings</u>		
RON	88.4	90.7
MON	80.3	81.9
<u>Blending Octane Values</u>		
RON	-	111.4
MON	-	96.3

Example 3

10% by volume of dimethyl carbonate was admixed with a gasoline containing 0.15g Pb/l as Tetra ethyl lead. The dimethyl carbonate was the same as used in Example 1.

The RON and MON of the gasoline and the blend were determined in a CFR engine and the Blending Octane Values calculated from the measured RONs and MONs. The results given in Table 5 show that the dialkyl carbonate is also useful in leaded gasoline.

Table 5

	<u>CFR Ratings</u>		<u>Blending Octane Values</u>	
	RON	MON	RON	MON
Leaded Gasoline	95.2	86.0	-	-
Leaded Gasoline/ dimethyl carbonate blend	96.3	88.0	106.2	106

Claims

1. A fuel composition suitable for use in internal combustion engines comprising a gasoline and a dialkyl carbonate having a boiling point of not more than 150°C.
- 5 2. A fuel composition as claimed in claim 1 characterised in that the alkyl groups are methyl, ethyl or isopropyl groups.
3. A fuel composition as claimed in claim 1 or claim 2 characterised in that the alkyl groups are the same.
4. A fuel composition as claimed in any of claims 1 to 3
- 10 characterised in that the composition comprises 0.1 to 50% by volume of dialkyl carbonate.
5. A fuel composition as claimed in claim 4 characterised in that the composition comprises 5 to 25% by volume of dialkyl carbonate.

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