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Fuel composition.

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A fuel composition suitable for use in spark ignition internal combustion engines comprises a high octane gasoline and an alkyl furan having a boiling point of not more than 150°C. Suitable alkyl furans are 2 methyl furan and 2,5 dimethyl furan. The gasoline may be leaded or unleaded.

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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.

It has been suggested that dimethylfuran may be useful as an octane improver for low octane gasolines. For example, a paper entitled "The Blending Octane Numbers of 2,5-dimethylfuran" by Hugh B. Nisbet, published in the Journal of the Institute of Petroleum, Vol 32, pp 162-166 (1946), discloses experimental results which show that dimethylfuran has a high blending octane value when

added to gasolines having an octane number of 57 or 69.5. However, the author states that when blended with a fuel of initial high octane number, e.g. isooctane, dimethylfuran possesses no advantage as a blending agent and actually gives a lower octane number than the basestock.

Contrary to the teaching of this paper, the applicants have found that alkyl furans having a boiling point of not more than 150°C may be used as an octane improver in high octane gasolines.

Thus, according to the present invention a fuel composition suitable for use in internal combustion engines comprises gasoline having a Research Octane Number higher than 85 and a Motar Octane Number higher than 75 and an alkyl furan having a boiling point of not more than 150°C.

The alkyl furans may be mono-or poly-alkylated and for the compounds to have a boiling point of not more than 150°C the alkyl group or groups may be methyl, ethyl and/or isopropyl. Preferably the compounds boil below 100°C. Preferred furans are methyl furans, particularly 2-methyl furan, which boils at 63°C or 2,5 dimethylfuran which boils at 93-94°C.

Alkyl furans can be obtained from various vegetable sources e.g. wood tars and sugars. In particular, 2-methyl furan can be produced by the catalytic hydrogenation of furfural, furfural itself being obtained from vegetable waste. 2,5 dimethylfuran may be prepared by passing mesityl oxide over a transition metal oxide catalyst in air at 300-500°C or by treating 2,5-hexadione with acid.

The proportion of alkyl furan may be from 0.1 to 50%, preferably from 5 to 25%, of the fuel composition.

Preferably, the gasoline has, before the addition of the alkyl furan, a RON of from 85 to 105, more preferably from 85 to 98 and a MON of from 75 to 95, more preferably 78 to 88. The high octane gasolines used in the present invention may comprise the following proportions of olefins, aromatics and saturates;

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

The gasoline 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 also be included in the compositions e.g. a scavenger, other oxygenated compounds and anti-icing or other known additives.

The alkyl furans have been tested in a range of gasolines both aromatic and olefinic and both leaded and unleaded. Blending octane values for the alkyl furans have been found to range from 120 to 132 RON and 99 to 105 MON giving increases in RON and MON of up to 4 numbers when added to gasoline at a concentration of 10% by volume.

The invention is illustrated by the following example:

Example 1

2-methyl furan 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 2-methyl furan were determined in a CFR engine. The Blending Octane Values (B.O.V.) were also calculated from the measured RONs and MONs of the gasolines and the 2-methyl furan/gasoline blends, using the formula,

$$\text{BOV} = \frac{\text{Blend Octane No.} - (\text{Basestock Octane No} \times \text{gasoline vol fraction})}{\text{alkyl furan volume fraction}}$$

$$\text{where volume fraction} = \frac{\% \text{ volume of component in the blend}}{100}$$

The 2-methyl furan was a commercial material supplied by the Aldrich Chemical Company. It had a boiling point of 63°C.

Inspection data on the aromatic gasoline and the corresponding gasoline/2-methyl furan blend are shown in Table 1. It will be seen that the addition of the 2-methyl furan did not significantly affect the distillation characteristics. The water tolerance was assessed according to the test method IP 98/44 Tentative.

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 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 temperature of immiscibility.

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

Table 1

	Gasoline (aromatic)	Gasoline/ 2-methyl furan blend
ASTM Distillation °C		
IBP	37.0	40.0
2% vol. recovered at	43.5	46.5
5% vol. " "	48.5	50.5
10% vol. " "	53.5	54.5
20% vol. " "	62.0	60.0
30% vol. " "	70.0	67.0
40% vol. " "	80.0	75.0
50% vol. " "	92.0	85.0
60% vol. " "	106.0	97.5
70% vol. " "	119.5	114.0
80% vol. " "	131.5	128.5
90% vol. " "	145.0	142.5
FBP	168.0	165.0
Recovery % vol.	97.0	98.5
Residue " "	1.0	1.0
Loss " "	2.0	0.5
Recovered at 70°C %vol	30.0	37.0
Recovered at 100°C "	56.0	63.0
Reid Vapour Press. lbs/m ² (KNm ⁻²)	7.5 (51.7)	7.7 (53.3)
Water tolerance at	-	
-20°C % vol	-	0.01
0°C	-	0.04
20°C	-	0.08

The CFR engine results and the calculated Blending Octane Values are shown in Table 2 below:

Table 2

5	<u>Blend Composition % vol.</u>				
	Gasoline 1 (Aromatic)	100	-	90	-
	Gasoline 2 (Olefinic)	-	100	-	90
	2-methyl furan	-	-	10	10
10	<u>CFR Ratings</u>				
	RON - clear	93.7	92.7	97.7	96.3
	MON - clear	84.0	83.0	86.1	84.6
15	<u>Blending Octane Values</u>				
	RON	-	-	133.7	128.7
	RON - average	-	-	131.2	
20	MON	-	-	105.0	99.0
	MON - average	-	-	102.0	

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

Example 2

10% by volume of 2,5, dimethylfuran was admixed with a gasoline from an aromatic basestock comprising 40.2% by volume aromatics and 59.8% by volume saturates. The dimethylfuran was a commercial product supplied by the Aldrich Chemical Company. It had a boiling point in the range 93-94°C.

Inspection data on the gasoline and the gasoline/2,5, dimethylfuran blend are shown in Table 3. It will be seen that the addition of the dimethylfuran did not significantly affect the distillation characteristics.

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

Table 3

		Gasoline (aromatic)	Gasoline/2,5, dimethylfuran blend
	<u>ASTM Distillation °C</u>		
5	IBP	45.0	44.0
	2% recovered at	53.0	54.0
	5% " "	59.0	61.0
	10% " "	64.0	66.0
10	20% " "	73.0	74.0
	30% " "	82.0	83.0
	40% " "	91.0	91.0
	50% " "	102.0	99.0
	60% " "	113.0	107.0
15	70% " "	125.0	117.0
	80% " "	137.0	131.0
	90% " "	151.0	148.0
	FBP	183.0	184.0
20	Recovery (%vol)	97.0	98.0
	Residue "	1.0	1.0
	Loss "	2.0	1.0
	Recovered at 70°C %vol	16.5	14.0
	Recovered at 100°C %vol	47.5	51.5
25	Reid Vapour Press. lbs/in ² (KN/m ²)	6.4 (44)	

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Table 4

<u>Blend Composition (% volume)</u>		
Gasoline (aromatic)	100	90
2,5, dimethylfuran	-	10
<u>CFR Ratings</u>		
RON	88.4	91.5
MON	80.3	82.5
<u>Blending Octane Values</u>		
RON	-	119.4
MON	-	102.3

Example 3

10% by volume of 2-methyl furan was admixed with an aromatic basestock gasoline containing 0.15g Pb/l as tetra ethyl lead. The 2-methylfuran was the same as used in Example 1. The gasoline comprised 41.8% by volume aromatics and 58.2% by volume saturates.

The RON and MON of the leaded gasoline and the blend were determined in a CFR engine and the Blending Octane Values calculated from the measured Research and Motor Octane Numbers. The results given in Table 5 show that the alkyl furan 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/ 2, methyl furan blend	98.4	88.0	127.2	106

Claims

1. A fuel composition suitable for use in internal combustion engines comprising a gasoline having a Research Octane Number higher than 85 and a Motor Octane Number higher than 75 and an alkyl furan 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 furan has a boiling point of less than 100°C.
3. A fuel composition as claimed in either of claims 1 or 2 characterised in that the alkyl furan has one or more alkyl groups selected from the group comprising methyl, ethyl and isopropyl groups.
- 10 4. A fuel composition as claimed in claim 3 characterised in that the alkyl furan is 2,5 dimethyl furan.
5. A fuel composition as claimed in claims 3 characterised in that the alkyl furan is 2 methyl furan.
6. A fuel composition as claimed in any of claims 1 to 5
15 characterised in that the composition comprises 0.1 to 50% by volume of alkyl furan.
7. A fuel composition as claimed in claim 6 characterised in that the composition comprises 5 to 25% by volume of alkyl furan.

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