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3,507,635

GELLED JET FUEL

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6 Claims

ABSTRACT OF THE DISCLOSURE

Gelled jet fuel is produced by adding polyisobutylene. The gel is fluidized by high speed shearing and may be pumped to a jet engine as a fluid.

This invention relates to jet fuel compositions and more specifically to a jet fuel which has been gelled by blending with polyisobutylene.

Jet fuel used in aircraft is potentially hazardous following a plane crash because it usually escapes from its ruptured container tank, spreads and burns. It is quite possible that in most crashes involving jet planes, many lives could be saved if the fuel remained in its tank, even if the tank was ruptured.

Jet fuel contained in large storage tanks at an airport also presents a similar potential fire hazard although on a lesser scale. Should a tank fire develop or if the jet fuel were to leak out and burn, a dangerous situation could develop. Not only would property and lives be endangered but airport operations could be interrupted and this too is undesirable.

Attempts have been made to gel jet fuel but problems then arise when attempting to pump the fuel at a controlled flow rate; in addition, combustion must be smooth and even, with a minimum of residue formation. Consequently no commercially acceptable gelled jet fuels are available which combine the properties of satisfactory gellation, controlled pumpability, and low residue formation while still maintaining the necessary power output on combustion.

With the above drawbacks in mind it is an object of this invention to provide a gelled jet fuel composition.

Another object is to provide a jet fuel which has been gelled by adding polyisobutylene.

Another object is to provide a gelled jet fuel which can be pumped at suitable speeds and constant rates.

Another object is to provide a gelled jet fuel-polyisobutylene composition which tends to remain in its container even after the container is ruptured.

Another object is to provide a gelled jet fuel-polyisobutylene composition which maintains satisfactory turbine engine fuel requirements when in a liquified state.

Another object is to provide a gelled jet fuel-polyisobutylene composition which yields a low residue upon burning.

These and other objects will become apparent from the description to follow.

The objects of the invention are attained by incorporating polyisobutylene into jet fuels thereby obtaining a gelled composition; when the gel is placed under high

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shear conditions, it liquifies due to degradation of the molecule and is suitable for pumping to the jet engine.

Commercial jet fuels contemplated by the invention include JP1, JP3, JP4, JP5, Jet A, Jet A1, etc. and surprisingly, it has been found that polyisobutylene is compatible with these jet fuels and forms a homogeneous gel therewith.

Suitable polyisobutylenes range in molecular weight from about 80,000 to 250,000 and higher. If the molecular weight is decreased below about 80,000 gel formation can only be attained at the expense of an undesirably high concentration of polyisobutylene. If the molecular weight is increased beyond about 250,000 the concentration of the polyisobutylene is decreased to about 1% or less.

Generally the concentration range of polyisobutylene which may be suitably employed varies from about 1% to about 8%. The lower concentration of polyisobutylene requires a higher molecular weight to provide the necessary properties of gellation and pumpability. As the concentration is increased, the molecular weight of the polyisobutylene must be decreased to retain the desired properties.

The maximum effective viscosity which may be employed when pumping the fuel is about 800 cps.

The minimum viscosity of the fuel in the gel state should be about 5000 cps. if the fuel is to remain substantially in its container following a rupture.

Consequently any suitable combination of molecular weight and concentration of polyisobutylene which will cause the jet fuel to gel at about 5000 cps. or greater in storage and flow at about 800 cps. or less when pumped to the jet engine is contemplated by this invention.

Superimposed over these factors is the temperature consideration which will vary the gel properties. Obviously a fuel may be a suitable gel at 0° F. but may not possess these properties if the ambient temperature is 100° F.; accordingly, since the operating temperature will vary the gel properties, this in turn will alter the molecular weight and concentration requirements of the polyisobutylene which produce these properties. At ambient temperature (about 75° F.), a 5% concentration in jet fuel of polyisobutylene having a molecular weight of about 140,000 has been found to produce the best gel properties.

Suitable commercial grades of polyisobutylene may be obtained from the Enjay Chemical Company under the trademark name of Vistanex. Suitable grades are designated by the Vistanex series MM L-80; MM 1-100; MM L-120; MM L-140 and MM L-250. Higher molecular weight grades (i.e. exceeding 250,000) may be employed also.

Table I illustrates the gel properties of various jet fuels blended with polyisobutylene. The shear degradation is produced by a Waring Blendor on a polyisobutylene-jet fuel blend for 15 minutes. The viscosity determinations were made at two different shear rates.

TABLE I

Sample	Polyisobutylene		Jet fuel	Brookfield viscosity, cps. 75° F. and shear rate, sec.-1			
	Mol. wt.	Conc., percent		0.12		12	
				Fresh	Degraded	Fresh	Degraded
1.....	140,000	1	JP4	170	110	9	7
2.....	10,000	5	JP5	170	105	9	9
3.....	80,000	8	JP5	5,000	800	3,500	690
4.....	140,000	5	JP4	10,000	330	4,900	250
5.....	140,000	5	JP5	9,000	400	5,200	150

It will be observed from Table I that the gelled fuel can be readily thinned by degradative high shear action, and in this low viscous state, may be pumped to the jet engine readily.

It will be observed also that Samples 1 and 2 do not

form a useful gel; Sample 3 represents the limits of acceptability because of low gel formation and high viscosity after undergoing shearing; Sample 4 and 5 are acceptable both with regard to gel formation and with regard to pumpability.

In actual practice, weighed amounts of polyisobutylene are added to the jet fuel in the fuel tank and the mixture is gelled by agitation for a suitable length of time. Prior to pumping to the jet engine, the gelled fuel is subjected to high shear degradative action by lowering a mixing device into the gel and converting it to a low viscous fluid which is then pumped to the engine. Preferably the mixer is adapted for travelling so when one portion of the gel is fluidized, the mixer is moved to another portion of non-fluidized gel in the fuel container.

Another advantage of this process is that the fuel becomes hot due to the high shear degradation; consequently the present process enables hot fuel to be pumped to the jet engine and this improves combustion efficiency.

In storage situations, e.g., at an airport, the jet fuel may be stored by itself in container tanks and the polyisobutylene can be added to the fuel when conditions warrant, e.g., overheating, threat of fire, leakage, etc. If desired, the polyisobutylene can be added in amounts only necessary to produce a thin gel. Such a low viscosity gel will be easier to pump and otherwise handle than a gel having the high viscosity properties required for use in a jet aircraft.

If desired, a polar solvent swelling agent such as acetone may be employed with the polyisobutylene to expedite dissolving in the jet fuel. Also, the polyisobutylene may be comminuted by powdering, dicing, etc. to decrease the time required for dissolving.

I claim:

1. A gelled jet fuel composition containing about 5% 35

by weight of polyisobutylene having a molecular weight of about 140,000.

2. A gelled jet fuel composition containing about 1% of polyisobutylene having a molecular weight beyond about 250,000.

3. A gelled jet fuel composition containing about 5-8% polyisobutylene having a molecular weight between about 80,000-140,000 and about 95-92% by weight of a jet fuel.

4. A gelled jet fuel composition containing about 5-8% polyisobutylene having a molecular weight between about 80,000-140,000 and about 95-92% by weight jet fuel, the concentration and molecular weight of polyisobutylene being selected to provide a Brookfield Viscosity (0.12 shear rate) of 5,000-10,000 for undegraded polyisobutylene and 330-800 for degraded polyisobutylene.

5. A gelled jet fuel composition containing about 5-8% polyisobutylene having a molecular weight between about 80,000-140,000 and about 95-92% by weight jet fuel, the concentration and molecular weight of polyisobutylene being selected to provide a Brookfield Viscosity of 3,500-5,200 for undegraded polyisobutylene and 150-690 for degraded polyisobutylene.

6. A gelled jet fuel composition containing about 8% polyisobutylene having a molecular weight of about 80,000 and 92% jet fuel.

References Cited

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,507,635 Dated April 21, 1970

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It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 21:

"Viscosity of" should read -- Viscosity (12 shear rate) of --

Signed and sealed this 22nd day of December 1970.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
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WILLIAM E. SCHUYLER, JR.
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