United States Patent

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[73] Assignee **The United States of America as represented by the Secretary of the Navy**

[54] METHOD FOR REMOVING DISSOLVED OXYGEN FROM HYDROCARBON GELS

3 Claims, No Drawings

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[50] **Field of Search** ..... 44/7 A; 149/109

[56] **References Cited**

UNITED STATES PATENTS

3,414,392 12/1968 Pruitt ..... 44/7 C

OTHER REFERENCES

Fieser & Fieser, " Organic Chemistry," Third Edition, Reinhold Publ. Co., New York, 1956, p. 631 [QD, 251, F5, 1956]

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ABSTRACT: A method of removing dissolved atmospheric oxygen from hydrocarbon liquids and gels which comprises incorporating pyrogallol in the alkaline portion of a three-component flame fuel system consisting of an alkaline portion, a nonalkaline portion, and a hydrocarbon liquid portion. This method effectively reduces swelling of the product formed.

METHOD FOR REMOVING DISSOLVED OXYGEN FROM HYDROCARBON GELS

BACKGROUND OF THE INVENTION

The present invention relates to a method of effectively reducing the swelling of gelled hydrocarbon flame fuels by removing dissolved atmospheric oxygen therefrom.

Liquid hydrocarbon may be desirably thickened or converted to gels which are useful in the making of incendiaries and the like. Dissolved atmospheric oxygen in hydrocarbon liquids and gels has created some undesirable effects such as swelling and foaming due to the formation and growth of gas bubbles throughout the liquids or gels. Hydrocarbon gels swell in a manner similar to rising bread dough and as a result of this swelling bombs or other devices filled with gel overflow decreasing their effective capacity. In sealed containers, pressures sufficient to cause rupture may develop. Also the overflow causes safety and housekeeping problems. The present invention alleviates the swelling problem by adding pyrogallol during the processing of the flame fuel gel.

SUMMARY OF THE INVENTION

This invention relates to a method for removing dissolved atmospheric oxygen from hydrocarbon liquids and gels thereby reducing postgel swelling which often occurs.

It is the general purpose of this invention to provide an improved flame fuel gel for use in incendiary bombs and other similar devices. Another object is to improve the usefulness of hydrocarbon gels by a method which alleviates swelling, (which is more pronounced when the ambient temperature rises) thereby increasing the effective capacity of bombs or other devices and decreasing the safety hazard and housekeeping problems.

DESCRIPTION OF THE INVENTION

The invention resides in the discovery that pyrogallol incorporated during the processing of a flame fuel gel alleviates swelling of the gel by removing dissolved oxygen therefrom. The fuel gel comprises three components: an alkaline solution, a nonalkaline solution, and a hydrocarbon liquid and is better described in U.S. Pat. No. 3,414,392 which issued 3 Dec. 1968. The method, briefly, comprises adding pyrogallol in a concentration of about 0.80 percent to the alkaline solution which consists essentially of sodium hydroxide, potassium hydroxide and water. At the time the above is mixed, the nonalkaline portion consisting essentially of linoleic acid and oleic acid was mixed with a liquid hydrocarbon consisting of aviation gasoline or turbine fuel. The alkaline portion containing pyrogallol was then mixed with the fuel and nonalkaline mixture to form the gel described in the above-cited U.S. patent.

The following ingredients are representative of the three component gelled fuel:

Nonalkaline Solution (A)	
Ingredients	Parts by weight
Blend of organic acids	79–81
A dispersant	19–21
Alkaline Solution (B)	
Ingredients	Parts by weight
Sodium hydroxide	28.5–30.5
Potassium hydroxide	15.9–17.8
Pyrogallol	00.77–0.80
Water*	54.83–50.9
*to make a total of 100.0 ± 1.00 parts	
Hydrocarbon Liquid (C)	
Aviation gasoline	
Turbine fuel (JP–4 and JP–5)	

The nonalkaline solution, designated A, the alkaline solution, designated B, and the hydrocarbon liquid fuel, designated C, are all brought to a temperature ranging between 70° and 85° F.

The acid blend of group A was mixed with the dispersant according to the art of U.S. Pat. No. 3,414,392 and 7.2 ml. were added to 150 ml. of turbine fuel from group C and thoroughly mixed.

The alkaline solution from group B was prepared as follows: 0.77 to 0.80 parts by weight pyrogallol was dissolved in 1.97 to 2.05 parts by weight of water. The pyrogallol addition was then thoroughly mixed with the alkali solution consisting of 28.50 to 30.5 parts of sodium hydroxide and 15.9 to 17.8 parts potassium hydroxide and water to make 100 parts by weight in a container from which air has been replaced with nitrogen.

The gel of U.S. Pat. No. 3,414,392 was prepared with the above ingredients by a convenient laboratory technique. The acid-fuel mixture consisting of liquid fuel (C) and nonalkaline solution (A) was poured down the inside wall of the container containing alkaline solution (B) so that the acid-fuel mixture formed a separate layer on top of solution (B). Sufficient acid-fuel mixture was added to completely fill the container and thereby exclude atmospheric oxygen. The three components were then vigorously mixed until gelation occurred in about 15 seconds. The gel possessed excellent consistency and stringiness characteristics and exhibited a marked reduction in swelling over gels prepared with the usual ingredients.

Pyrogallol in a concentration of 0.08 percent in the alkaline solution as described herein effectively reduces hydrocarbon gel swelling. Pyrogallol is very active to oxygen in alkaline conditions but reacts slowly in acid or neutral medium.

Because pyrogallol absorbs oxygen from air (and thus has its oxygen absorbing capacity depleted) suitable precautions should be taken during mixing and filling operations to minimize contact of pyrogallol-containing solutions with air. Strength of the solution shall be preserved by replacing any air in contact with the alkaline solution with nitrogen. Since pyrogallol dissolves with difficulty in concentrated alkali solution, it is desirable to first dissolve the pyrogallol in water. Any such pyrogallol addition should then be thoroughly mixed with the alkali solution in a container from which the air has been replaced with nitrogen.

The alkaline component (B) may be made from commercial grade caustic soda, caustic potash and pyrogallol. It may be produced either from solid chemicals, or from solutions of the solid chemicals, or from any combination of these.

The nonalkaline component (A) is a blend of organic fatty acids and a dispersant. The fatty acid portion is comprised of a mixture of fatty acids with an acid value greater than 195 and less than 202, an iodine value greater than 135 and less than 146, a liter of 41° F. or lower, and a fatty acid distribution approximating 60 percent of linoleic acid, 32 percent of oleic acid, 3 percent of other unsaturated acids, 5 percent of saturated fatty acids, and minor constituents. The fatty acid portion is commercially available as Neofat 140 and Emersol 310.

The dispersant is composed principally of an addition product of ethylene oxide and technical dehydroabiethylamine (containing 5 moles of reacted ethylene oxide per mole of dehydroabiethylamine). Approximately 15 percent by weight unsubstituted technical dehydroabiethylamine accompanies the ethyoxylated portion. The above mixture is dissolved to give a 70 percent by weight solution in isopropyl alcohol. This material is commercially available as Polyrad 0515A.

Experimentally it was found to be expedient to accelerate and amplify the swelling tendency of gels by raising their temperature by 30° F. The amount of volume expansion per degree Fahrenheit was used to compare the relative swelling characteristics of various gels. The comparison of expansion per degree Fahrenheit was made of the present aviation gasoline gel (with pyrogallol) and the regular aviation gasoline gel (without pyrogallol) with the following results:

Sample Description	% Expansion per Degree Fahrenheit
Regular gel 1	0.210

Regular gel II	0.180
Regular gel III	0.210
Regular gel IV	0.210
Gel with pyrogallol I	0.041
Gel with pyrogallol II	0.045
Gel with pryogallol III	0.036
Gel with pyrogallol IV	0.046

The above-described process using JP–4 and JP–5 jet fuels also gave good results. The gels proved successful for use as the filler in fire bombs. Swelling of the gel was considerably alleviated.

What is claimed is:

1. A method of removing dissolved atmospheric oxygen from a flame fuel gel produced from the reaction of an alkaline solution consisting essentially of sodium hydroxide and potassium hydroxide, a nonalkaline solution consisting essentially of linoleic acid, oleic acid and a dispersant, and a hydrocarbon fuel consisting essentially of aviation gasoline or turbine fuel, said method comprising

first incorporating pyrogallol in said alkaline solution;

then mixing said alkaline-pyrogallol solution with said nonalkaline solution and hydrocarbon fuel.

2. The method in accordance with claim 1 wherein the concentration of pyrogallol in said alkaline solution is about 0.80 percent.

3. A flame fuel comprising

a hydrocarbon fuel selected from the group consisting of aviation fuel and turbine fuel bound in a matrix comprising the reaction product obtained by mixing gelling proportions of an alkaline solution consisting essentially of an aqueous solution of sodium hydroxide, potassium hydroxide and pyrogallol and a nonalkaline solution consisting essentially of unsaturated fatty acids and a dispersant composed of ethylene oxide and dehydroabiethylamine.

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