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GEL-TYPE FUEL AND METHOD OF MAKING SAME

James V. Hunn, Avon Lake, Ohio, assignor to The Sherwin-Williams Company, Cleveland, Ohio, a corporation of Ohio

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This invention relates as indicated to gel-type fuels and to a new and improved process for producing these materials. Generally these gels range in consistency from thin, stringy liquids to relatively hard solids, and for most purposes comprise gels of light hydrocarbons.

It has been known for a considerable period of time that the so-called "solid fuels" could be produced by gelling a low boiling fuel material, such as petroleum distillate, e. g., gasoline; or a coal tar distillate, e. g., benzene; or mixtures of various petroleum distillates, mixtures of various coal tar distillates, and mixtures of petroleum distillates with coal tar distillates with a gel-forming material such as a soap of a relatively high molecular weight fatty acid. Many soaps have been used for this purpose including sodium, potassium, lithium, barium, calcium, aluminum, etc. soaps. Most usually the fatty acid radical has been derived from such acids as stearic acid, oleic acid, palmitic acid, cocoanut oil acids, naphthenic acids, etc., and mixtures of the same. In every instance, however, the soap which has been employed has been either a neutral soap or a basic soap, i. e., having a free hydroxyl group attached to the polyvalent metal.

A number of patents have been issued recently disclosing materials of this type, among which are included the patents to Stirlen, 2,246,552; Laliberte, 2,385,361; Minich, 2,390,609; Gebhart, 2,447,064; Beerbower, 2,445,649; and Mysels, 2,492,173. In general, these patents disclose the use of various soaps such as sodium resinate, various aluminum soaps, etc., which materials may be produced in situ or prepared externally and subsequently added to the material to be gelated. The reaction employed in making the soaps is either a direct neutralization of the fatty acid with sodium hydroxide, or a double decomposition reaction from the sodium salt. In each instance water is present during the formation of the soap, either as water of neutralization or as may be incorporated by reason of the use of aqueous solutions of the reactant materials.

By the process hereinafter more particularly described, it has been found that gel-type fuels containing no water can be produced in a simple one step reaction and having a composition which may be controlled to an extent heretofore unknown. The absence of any moisture, other than trace amounts inadvertently entering the system, from the compositions of this invention greatly alleviates problems of corrosion caused by the presence of water in the previously known compositions.

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It is, therefore, a principal object of this invention to provide a new and useful gel-type fuel, and to provide a novel method for producing the same.

Another object of this invention is to provide a substantially anhydrous gel-type fuel.

Another object of this invention is to provide a process of manufacturing a substantially anhydrous gel-type fuel.

Another principal object of this invention is to provide a new "jellied" gasoline, and a novel method of producing the same, which product is primarily useful as a military weapon.

Other objects of this invention will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the appended claims, the following description setting forth in detail certain embodiments of the invention, such disclosed means constituting, however, but a few of the various forms in which the principle of my invention may be employed.

Broadly stated, this invention comprises in combination a normally liquid hydrocarbon material, hereinafter more particularly described, and an alkoxy aluminum carboxylate having the general formula

$$(RO—)_{n-1}Al(—X—C:X'—R')_{4-n}$$

wherein R is an alkyl radical of from 1 to 3 carbon atoms, R' is an aliphatic radical of from 6 to 30 carbon atoms, X and X' are each selected from the group consisting of oxygen and sulphur, and n is an average number at least 1 and less than 4, in an amount ranging from .5% to about 20% by weight of the composition. More particularly, this invention comprises a method for producing a gel-type fuel which comprises adding to the organic hydrocarbon fuel base a predetermined amount of aluminum metal, adding from about 4 to about 20 times the weight of the aluminum of a substantially dry, aliphatic alcohol

of less than 4 carbon atoms, said alcohol containing in solution a trace of a soluble mercury compound, and adding a free aliphatic carboxylic acid containing from 6 to about 30 atoms in an amount sufficient to form at least the mono-aluminum soap. As the number of carbon atoms decreases below about 12–14 in the acyl radical, solubility difficulties are encountered and it is frequently necessary to resort to the use of solubilizing agents or stabilizing agents or means to obtain a useful product. Thus, acids of 12 or more carbon atoms are preferred to avoid the additional material or treatment. Hydrocarbon-soluble sulphonates, wetting agents, etc. and fatty oils may be added for solubilizing and stabilizing purposes, if desired.

The organic fuel bases which may be used in accordance with the principles of this invention are well known and include as the most important and desirable class various low molecular weight aryl and alkyl hydrocarbons principally the petroleum distillate fuel fractions, i. e., gasoline, naphtha, mineral spirits, kerosene, and fuel oil. Of course, it is clear that this invention can be applied to the heavier petroleum distillate fractions such as mineral lubricating oils, e. g., SAE 10, 20, 30 and 40 weight oils for the production of bodied oils and greases. Instead of mixed hydrocarbons of the type just mentioned, pure hydrocarbons such as hexane, cyclohexane, methyl cyclohexane, heptane, diisobutylene, cyclohexene, octene-1, octane, 2-ethyl hexane, trimethyl pentane. nonene-1, nonane, decane, decene, dodecane, dodecene, cetane, cetene and the various known isomers and mixtures of the foregoing saturated and/or unsaturated aliphatic hydrocarbons, may be used. Of the aromatic hydrocarbons, which are sometimes less desirable because of their smoking tendencies, there may be used benzene, toluene, xylene, and the like. Alcohols have been used in the production of gel-type fuels such as methyl alcohol and ethyl alcohol, and may be accordingly used in the production of compositions of this invention, although such materials do not generally yield as satisfactory a gel-type product. Ethers and ketones may also be used, but again, the presence of the oxygen atom in the molecule appears to have an undesirable effect on the product. Accordingly, it is preferred to employ hydrocarbon materials of the aliphatic, aromatic or mixed aliphatic-aromatic type, which materials have boiling points within the range of those compounds ordinarily used for fuel purposes, and more particularly, boiling points within the range of from about 100° F. up to about 400° F. Mixtures of alcohol and an aliphatic and/or aromatic hydrocarbon may also be used in accomplishing the purposes of this invention. A typical example of this class is a blend of gasoline, benzene, and ethyl alcohol or methyl alcohol.

With respect to the metallic ion of the alkoxy polyvalent metal carboxylate, the aluminum derivative has been found most satisfactory from the standpoint of properties in the final product as well as in the procedural steps by which said product is produced. Magnesium may also be used although the characteristics of the product obtained in this case are not as satisfactory as those resulting when aluminum is employed.

The aluminum soaps of this invention have the following general formula:

$$(RO—)_{n-1}Al(—X—C:X'—R')_{4-n}$$

wherein R is an alkyl radical of from 1 to 3 carbon atoms, R' is an aliphatic radical of from 6 to about 30 carbon atoms, X and X' are each selected from the group consisting of oxygen and sulphur, and n is an average number at least 1 and preferably less than 4, including 2 and 3, and fractions within the range. It is clear that although theoretical quantities of pure reactants may be used in the preparation of the soaps, in the usual production, the composition will contain a mixture of aluminum soaps having the same general formula wherein n varies from 1 to 3. Minor amounts of the compound represented where n is 4 may also be present. In any event, the preferred average value of n is between 1 and 2, i. e., n may have an average value of 1.2, 1.5, 1.7, etc. for example, although soaps having average values for n of 2.2, 2.8, etc. may be produced and used in accordance with this invention.

Accordingly, R may be methyl, ethyl, propyl or isopropyl as derived from the corresponding R—OH compound. R' is an aliphatic radical and preferably a hydrocarbon radical derived through the use of a free aliphatic or alkyl carboxylic acid. The thio acids may be used to replace part or all of the oxy-carboxylic acid or acids. These may be the thiolic, thionic, or dithio type. Among the acids thus available for use in forming the soaps and compositions of this invention are the mono basic fatty acids including n-hexanoic, n-octanoic, dithio-octanoic, 2-ethyl hexanoic, decanoic acids, dodecanoic, undecylenic acids, lauric acids, oleic acid, ricinoleic acid, linoleic acid, stearic acid, thiol-stearic acid, hydroxy stearic acid, phenyl stearic acid, dichlorstearic acid, palmitic acid, cosenoic acid, cetoleic acid, naphthenic acids, abietic acid, rosin acids, hydrogenated rosin acids, linseed oil acids, cocoanut oil acids, soyabean oil acids, cottonseed oil acids, tall oil acids, castor oil acids, palm oil fatty acids, sperm oil acids, tallow acids, etc., and mixtures of synthetic acids or derived acids with other synthetic or derived acids, or with acids derived from natural oils. For most purposes, aliphatic carboxylic acids or mixtures thereof containing from 12 to 28 carbon atoms are preferred. The term "aliphatic carboxylic acid" as used herein and in the appended claims is to be deemed inclusive of those carboxylic acids, such as, rosin acids, tall oil acids, and naphthenic acids, which contain or are characterized by cycloaliphatic nucleii.

As will be exemplified hereinafter, a trace of an alcohol-soluble mercury salt is used to activate the aluminum. By "alcohol soluble" is meant that a sufficient amount is soluble in the alcohol to activate the aluminum, although for other practical purposes the mercury salt is commonly considered insoluble in the alcohol. In general, amounts ranging from 0.005 up to 0.5 gram, and preferably from 0.05 to 0.1 gram per $\frac{1}{10}$ mol of aluminum are used. The upper limits in these cases are practical limits and larger amounts of mercury salt may be used if desired. In many instances, however, problems of contamination and removal of mercury are thereby encountered. The term "trace" as used herein and in the appended claims is to be construed as an amount detectable by ordinary methods. Practical quantities are as given above. Mercuric chloride, mercuric acetate, mercuric bromide, mercuric iodide, mercuric fluosilicate, mercuric iodobromide, mercuric iodochloride, mercuric nitrate, mercuric thiocyanate etc. may be used. Soluble mercurous salts such as mercurous chlorate may also be used. Such mercury salts are preferably used in

the unhydrated form, although with the minor amount employed in these reactions, the added water of hydration will be virtually insignificant.

Three methods have been developed for the production of the gel-type fuels of this invention, the first of which is most satisfactory for reasons which will appear.

METHOD NO. 1

In this procedure, the required amount of aluminum metal in the form of foil, turnings or powder is treated with an amount of alcohol, such as methyl or ethyl alcohol, sufficient to cover the aluminum, containing a trace of a soluble mercury salt such as mercuric chloride. The aluminum and alcohol are warmed until an active evolution of hydrogen takes place indicating that the aluminum is being converted to aluminum methylate or ethylate. A mixture of fatty acids and the organic fuel material is then added in sufficient quantities to produce a mono, di or tri soap and to obtain the final desired concentration of the soap in the organic fuel. This reaction takes place in situ.

METHOD NO. 2

By this procedure, the aluminum is first activated in a small quantity of alcohol containing the mercuric salt in the same manner as outlined in Method No. 1. Sufficient alcohol is used to convert all the aluminum to aluminum alcoholate. As soon as hydrogen is rapidly evolved, showing that the aluminum has been sufficiently activated, about ⅓ of the total amount of organic fuel to be used is then added to the reaction mass. The reaction is then allowed to continue until all the aluminum has been converted to aluminum alcoholate, resulting in a fine dispersion of aluminum alcoholate in the organic fuel. To this solution is then added the remainder of the organic fuel containing the desired quantity of fatty acid to produce either a mono, di or tri soap as may be desired, and in the desired concentration in the final product. Within 30 to 60 seconds, the entire mass then converts to the final gel consistency.

METHOD NO. 3

For some purposes, Method No. 2 has the drawback that the dispersion of aluminum alcoholate in the solvent (fuel) will not remain uniform due to settling of the aluminum methylate. To overcome this difficulty the following procedure was developed: The aluminum is first activated with a mercuric salt in the presence of a sufficient amount of alcohol to convert at least ½ of the aluminum to the alcoholate. After the aluminum has become reactive, which is shown by the beginning of hydrogen evolution, the dispersing fuel and ½ of the fatty acid required to produce the desired soap is then added. The reaction is then allowed to go to completion which is shown by the complete disappearance of the aluminum metal. This results in the production of a mono-aluminum soap in which is dispersed in colloidal form the excess of aluminum alcoholate. The formation of some aluminum soap appears to aid in the dispersion of the aluminum alcoholate as formed and to hold it in uniform suspension. The desired gel is then formed at any time by the addition of the remaining fatty acid. By this procedure, the completion of the gel structure is slow due to the retarding effect of the dispersed aluminum soaps already present. Moreover, it has been observed that although the gel structure immediately following preparation is substantially the same as that produced in Method No. 1, upon standing the gel thins down considerably.

It becomes convenient at this point to illustrate the methods of producing the novel compositions of this invention.

Method #1, Example #1

ALUMINUM TRI SOYATE

To a 1-liter, 3-necked round bottom flask equipped with agitator, reflux condenser and thermometer was added 0.9 gm. of aluminum foil and 19.8 gms. of methyl alcohol, to which had been added a trace of mercuric chloride. Gentle heat was applied until hydrogen was rapidly evolved. There was then added 28 gms. of soy bean oil fatty acid and 388 gms. of white gasoline. The reaction was allowed to proceed with agitation and gentle heating until all of the aluminum metal had disappeared. This resulted in a dispersion of tri-aluminum soyate in white gasoline having a 6.6% concentration of soap. This product was of very thin consistency.

Method #1, Example #2

ALUMINUM DI SOYATE

This example was carried out following the same procedure as Example #1, except that the quantity of aluminum was increased to 1.35 gms. in order to form the di-soap. The resulting composition contained 6.72% of aluminum soap and was of a heavier consistency than Example #1, but not completely jelled.

Method #1, Example #3

ALUMINUM MONO SOYATE

This experiment was carried out in the same manner as the two preceding examples, except that the aluminum was again increased to 2.7 gms. in order to produce the mono soaps. The resulting mixture contained 7.6% soap and formed a thick, cohesive, sticky gel.

Method #1, Example #4

ALUMINUM MONO NAPHTHENATE

The procedure and composition of this example was the same as in Example #3, except that 23.6 gms. of naphthenic acid was used in place of the soy bean oil fatty acid. The product obtained contained 6.6% of the mono soap and was a thick, stringy gel.

Method #1, Example #5

ALUMINUM MONO LAUREATE

The procedure used in this example is the same as those previously outlined with the following proportions: 2.6 gms. of aluminum, 20.4 gms. of 90% lauric acid, 563.2 gms. of white gasoline and 19.8 gms. of methyl alcohol. The product of this example contained 3.8% of aluminum mono laureate and was a thick gel slightly shorter and less stringy than that produced with naphthenic in the previous example.

Method #2, Example #6

ALUMINUM MONO SOYATE

2.7 gms. aluminum foil and 19.8 gms. of methyl alcohol containing a trace of mercuric chloride was added to the flask and gently heated until hydrogen was rapidly evolved. 130 gms. of white gasoline was then added and the reaction allowed to proceed with agitation until all of the aluminum had disappeared. The product obtained

was a dispersion of aluminum methylate in white gasoline.

A mixture of 258 gms. of white gasoline and 28 gms. of a soya fatty acid was placed in a beaker. To this was then added the dispersion of aluminum methylate in gasoline. The mixture was stirred rapidly and allowed to stand at room temperature. A firm, sticky gel was formed in a few minutes.

Method #3, Example #7

ALUMINUM MONO SOYATE

2.7 gms. aluminum and 19.8 gms. methyl alcohol containing traces of mercuric chloride was added to the reaction flask and gently warmed until hydrogen was being rapidly evolved. To the reaction mass was then added 388 gms. of white gasoline containing 14 gms. of soya bean oil fatty acids. The mass was then allowed to react with agitation and gentle heating until all of the aluminum had disappeared. The product obtained at this point was a flowable, opalescent material. To this product when cold was added with stirring 14 additional gms. of soya bean oil fatty acid. The immediate action was a thinning of the mixture, but which on standing for upwards of 48 hours produced a stiff gel comparable with that produced with Method #1, Example #3. On standing, this product lost much of its initial viscosity and became a thin syrup.

Method #1, Example #8

MIXED ALUMINUM ALKOXY-DI AND TRI-SOYATE

2.7 gms. of metallic aluminum in the form of turnings or foil were placed in a 3 necked round bottom flask equipped with agitator, reflux condenser and means of heating. To this was then added 23.7 gms. of methyl alcohol containing a trace of mercuric chloride. This amount of alcohol is sufficient to completely cover the aluminum as it rests in the bottom of the flask. The aluminum and alcohol were allowed to stand at room temperature, or they may be heated jointly for a few minutes until hydrogen starts to evolve. 75 gms. (theory 84 gms.) of soya bean fatty acids in 300 gms. of SAE #10 motor oil were then added. The mixture was then agitated with slow heating to a slight reflux of the alcohol until all of the aluminum was in solution. At this point the temperature was raised and the excess methyl alcohol distilled off and recovered. The product obtained in this case was a solid, stiff gel and the molecular ratio in this example was 1 mol of aluminum to less than 3 mols of fatty acid to form a nearly neutral soap.

Method #1, Example #9

ALUMINUM TRI SOYATE

The procedure of Example 8, and the quantities of reactants, was repeated except that the theoretical amount of soya fatty acids, 84 grams, was used. Again, a solid, stiff gel was obtained from the SAE #10 oil. This product was neutral and the fact that all the aluminum metal was consumed in the reaction indicated the formation of the tri-soap.

Aluminum soaps made by the procedures outlined above differ in many respects from those made by conventional methods.

Experience has shown that mono and di-aluminum soaps made by precipitation methods have practically the same jelling power; it has also been observed that mono soaps made by precipitation methods are much less soluble than di soaps which is indicated by the rate of dispersion and the clarity.

Mono and di-aluminum soaps made by the methods outlined here have greatly differing jelling power. Only about one-half as much mono soap as di soap is required to produce approximately equivalent consistency. These results have been shown in Examples #1, 2 and 3.

The mono and di soaps produced by this method also differ in composition from those produced by precipitation methods. A di soap produced by precipitation methods would have the composition of mono-hydroxy, di-stearate, or di-soyates, etc., and the mono soap would be a di-hydroxy, mono-stearate, or di-soyate, etc.

Mono and di soaps produced by the method outlined here in the case of di-soap would have the composition mono-methylate, di-stearate, or soyate, etc., and the mono soap would be a dimethylate, mono-stearate or soyate, etc. In other words by this procedure the normal hydroxyl group are replaced by alkoxy groups.

While all of the examples and discussions given above had been confined to the use of methyl alcohol, this process is not limited to the use of this alcohol. Any other alcohol may be used which is capable of reacting with the activated aluminum to form the alcoholates such as ethyl, propyl, etc. If these other alcohols are used, the resulting product will contain the ethoxide, propoxide, etc. radicals in place of the methoxide radical.

All of the examples given here have been limited to aluminum soaps because of the higher jelling power of these soaps. However, it has been observed that the mono magnesium soaps produced by this method have a considerable degree of jelling power while the di-magnesium soaps seem to have little or no jelling power at any concentration.

It has been previously indicated that amounts of the alkoxy aluminum carboxylate ranging from 0.5% up to about 20% of the composition may be employed. The ultimate use of the end product determines to a large measure the amount to be used. Where it is desired to body the hydrocarbon only slightly, as in the case of lubricating oils, and obtain other advantages of the additive, amounts generally less than about 3% are employed. Where thickening to a greater extent is desired, 3% to 5% is employed. In the lighter hydrocarbons, gels of varying degrees of solidity are obtained at concentrations of 5% to 20%, and preferably 5% to 8%. Beyond 8% to 9%, up to about 20%, there is observed increasing difficulty in ignition of the gel-type fuel as well as increasing difficulty in maintaining burning. For most practical purposes, it is preferred to employ reactant quantities which will result in an alkoxy aluminum carboxylate content of from 3% to about 8%.

In the previous examples reference has been had to metallic aluminum in the foil or turning form. It is in this form that metallic aluminum appears to yield the best results in accordance with this invention. However, lump aluminum may be used in the same manner although because the surface area is smaller in proportion to the amount of aluminum, the reaction will accordingly take a longer period of time. Also because of the smaller surface area, smaller amounts of the mercuric salt are required to activate the aluminum. Powdered aluminum may also be used in this invention although

experience has shown that better results are obtained if larger quantities of the mercuric salts are employed, still, however, within the range as indicated above.

It is, of course, to be understood that the alcohol used to cover the aluminum should be as nearly anhydrous as possible in order to prevent the formation of hydroxy derivatives of the aluminum carboxylates which apparently destroy the character and effectiveness of the soap in the gel structure. Methyl and ethyl alcohols in the anhydrous state are, of course, readily available, and isopropyl alcohol, although slow in reaction with the aluminum, may be purchased in the anhydrous state or dried by chemical methods. The higher the molecular weight of the alcohol, the more difficult the reaction between the alcohol and the aluminum becomes even though activated with mercury.

Specific examples of aluminum soaps which are produced in situ forming the compositions of this invention by the methods outlined in detail above and illustrated by working examples include: dimethoxy aluminum octoate, dimethoxy aluminum dithiooctoate, methoxy aluminum di-(2-ethyl hexoate), diethoxy aluminum ricinoleate, methoxy aluminum dioleate, aluminum trioleate, dimethoxy aluminum stearate, diethoxy aluminum dichlorstearate, methoxy aluminum di-palmitate, methoxy aluminum diabietate, dimethoxy aluminum abietate, dimethoxy aluminum resinate, diisopropoxy aluminum resinate; methoxy aluminum di-soaps of linseed oil acids, cottonseed oil acids, sunflower seed oil acids, cocoanut oil acids, castor oil acids, dehydrated castor oil acids, etc. and mixtures of two or more such soaps. For example, in lieu of using a pure acid in any of the outlined methods, a 50–50 mixture of two acids, e. g. naphthenic and 2-ethyl hexanoic acids, may be employed.

This application is related to my co-pending application Serial No. 173,483 filed July 12, 1950.

Other modes of applying the principle of this invention may be employed instead of those specifically set forth above, changes being made as regards the details herein disclosed, provided the elements set forth in any of the following claims, or the equivalent of such be employed.

I, therefore, particularly point out and distinctly claim as my invention:

1. A substantially anhydrous composition of matter comprising in combination a major amount of a normally liquid hydrocarbon and from 0.5 to about 20% by weight of an alkoxy aluminum carboxylate having the general formula

$$(RO—)_{n\ 1}\ Al(—X—C{:}X'—R')_{4-n}$$

wherein R is an alkyl radical of from 1 to 3 carbon atoms, R' is an aliphatic radical of from 6 to 30 carbon atoms, X is selected from the group consisting of oxygen and sulphur, X' is selected from the group consisting of oxygen and sulphur, and n is an average number from 1 and less than 4.

2. A composition in accordance with claim 1 in which R is methyl.

3. A composition in accordance with claim 1 in which the acyl radical (—X—C:X—R') is derived from a vegetable oil acid.

4. A composition in accordance with claim 1 in which the acyl radical (—X—C:X—R') is derived from soya bean oil acids.

5. A composition in accordance with claim 1 in which the acyl radical (—X—C:X—R') is derived from naphthenic acids.

6. A composition in accordance with claim 1 in which the acyl radical (—X—C:X—R') is derived from rosin acids.

7. A composition in accordance with claim 1 in which the acyl radical (—X—C:X—R') is derived from a mixture of aliphatic carboxylic acids having from about 14 to about 28 carbon atoms.

8. A composition in accordance with claim 1 in which the normally liquid hydrocarbon has a boiling point of from 100° F. to about 400° F.

9. A composition in accordance with claim 1 in which the normally liquid hydrocarbon is a gasoline fraction of petroleum.

10. A composition in accordance with claim 1 in which the normally liquid hydrocarbon is a gasoline fraction of petroleum and the amount of alkoxy aluminum carboxylate is from 3% to 8% by weight.

11. A composition in accordance with claim 1 in which the normally liquid hydrocarbon is a lubricating oil having an SAE weight of from 10 to 40.

12. A composition in accordance with claim 1 in which the normally liquid hydrocarbon is a naphtha fraction of petroleum.

13. A composition in accordance with claim 1 in which the alkoxy aluminum carboxylate is dimethoxy aluminum monosoyate.

14. A composition in accordance with claim 1 in which the alkoxy aluminum carboxylate is dimethoxy aluminum mononaphthenate.

15. A composition in accordance with claim 1 in which the alkoxy aluminum carboxylate is dimethoxy aluminum monorosinate.

16. A substantially anhydrous composition of matter comprising in combination a major amount of a normally liquid petroleum fraction boiling between about 100° F. and about 400° F., and from 3% to about 8% by weight of an alkoxy aluminum monocarboxylate having the general formula:

$$(RO—)_2\ Al—O—C{:}O—R'$$

wherein R is an alkyl radical of from 1 to 3 carbon atoms, and R' is an aliphatic radical containing from 12 to 28 carbon atoms.

17. A substantially anhydrous jellied gasoline consisting essentially of a major amount of a gasoline petroleum fraction, and from 5% to 8% by weight of dialkoxy aluminum monosoyate, in which the alkoxy group contains from 1 to 3 carbon atoms.

18. The method of producing a substantially anhydrous jellied gasoline defined in claim 14 which comprises the steps of adding a sufficient amount of an anhydrous R—OH compound, where R is an alkyl group of from 1 to 3 carbon atoms, to cover an amount of free aluminum metal sufficient to yield from 3% to about 8% by weight of alkoxy aluminum monosoyate in the final composition, said R—OH compound containing a trace of a soluble mercury compound, and adding after the initial reaction has commenced, a calculated amount of soya bean oil fatty acids intermixed with gasoline whereby the total dilution with gasoline is such as to yield a 3% to 8% solution, and the amount of acid is such as to form at least the mono-soap and insufficient to form the tri-soap.

19. The method of producing a substantially anhydrous gel-type fuel which comprises the steps of adding a sufficient amount of an anhydrous R—OH compound, where R is an alkyl group of from 1 to 3 carbon atoms, to cover an amount of free aluminum metal sufficient to yield

from 3% to about 8% by weight of alkoxy aluminum carboxylate in the final composition, said R—OH compound containing a trace of a soluble mercury compound, and adding after the initial reaction has commenced, a calculated amount of a fatty acid containing from 12 to 24 carbon atoms intermixed with a normally liquid hydrocarbon fuel material whereby the total dilution with such fuel is such as to yield a 3% to 8% solution, and the amount of acid is such as to form at least the mono-soap and insufficient to form a tri-soap.

20. A composition in accordance with claim 1 in which the alkoxy aluminum carboxylate is a mono-alkoxy aluminum dicarboxylate.

21. The method of producing a substantially anhydrous gel type fuel which comprises the steps of adding a sufficient amount of an anhydrous R—OH compound, where R is an alkyl group of from 1 to 3 carbon atoms, to cover an amount of free aluminum metal to yield from 3% to about 8% by weight of alkoxy aluminum carboxylate in the final composition, said R—OH compound containing a trace of a soluble mercury compound, and adding after the initial reaction has commenced a mixture of a normally liquid hydrocarbon and a fatty acid containing from 6 to 30 carbon atoms, the total amount of acid on a stoichiometric basis being such as to form at least the mono-soap and insufficient to form the tri-soap, and the amount of normally liquid hydrocarbon being such as to yield a soap concentration of from 0.5 to about 20% by weight.

JAMES V. HUNN.

REFERENCES CITED

The following references are of record in the file of this patent:

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2,385,363	Laliberte	Sept. 25, 1945

Certificate of Correction

Patent No. 2,618,536 November 18, 1952

JAMES V. HUNN

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 1, line 32, for "Beerbower, 2,445,649" read *Beerbower, 2,455,649*; column 9, line 57, for that portion of the formula reading "$(RO—)_{n\ 1}$" read $(RO—)_{n-1}$;

and that the said Letters Patent should be read as corrected above, so that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 7th day of April, A. D. 1953.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.