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A PROCESS FOR PRODUCING PETROL

This invention relates generally to a process for producing petrol.

Petrol (known in the Unites States as gasoline)
5 is a petroleum fuel having an octane number of at least 60. It is made up of a mixture of volatile hydrocarbons suitable for use in a spark-ignited internal combustion engine, as defined in The Condensed Chemical Dictionary,
10 9th Edition, p.407. The major components of petrol are branched-chain alkanes (often known as branched-chain paraffins), cycloalkanes (often known as cycloparaffins), alkenes (often known as olefins), and aromatics. There are several
15 processes for producing petrol, including distillation or fractionation both yielding a straight-run product of a relatively low octane number which is primarily used for blending; thermal and catalytic cracking; reforming; polymerization;
20 isomerization; and dehydrocyclization. Of these processes, all but the first are various means of converting hydrocarbon gases into motor fuels by modifications of chemical structure,

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the modifications usually involving catalysts. Although the overwhelming present source of petrol is crude oil, it may also be produced from shale oil and tar sands, as well as by hydrogenation or gasification of coal.

As noted in Van Nostrand's Scientific Encyclopedia, 5th Edition, pp.1745 to 1749, the composition of petrol has varied over the years. In the infancy of automobile transportation, petrol was a relatively simple mixture of petroleum fractions derived from straight-run and thermally-cracked stocks. Over the years, there was an increase in the compression ratio of internal combustion engines so as to improve the overall engine performance and efficiency. As the compression ratio increased, the fuel octane number also had to increase in order to prevent pre-ignition (also known as knocking).

Additives were eventually developed which increased the octane number. Additives were also found to perform other functions, such as the prevention of: carburettor icing and fouling; fuel system corrosion; and poor fuel distribution. As ecological problems are now a major concern, the use of lead alkyls as fuel additives is beginning to decline and catalytic converters are being installed in automobile engines. With unleaded petrol and the new anti-pollution standards, it became more expensive to produce a petrol of a purity which would not poison a catalytic converter but still be of a sufficiently high octane number to deliver good performance. In addition, the curtailed use of certain fuel additives, such as lead alkyls, has increased the cost of such high octane petrol.

The cost of petrol is also influenced by the world market price for petroleum fuels.

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Since petroleum fuels are created over a very long period of time, petroleum reserves are considered to be a depletable natural resource. As such, the price of petroleum fuels is effected by the world supply and world demand for such fuels, as well as current production capacity. Additionally, the supply of petroleum fuels is subject to depletion over a long period of time.

10 In view of the depletable nature of natural petroleum, as well as the fact that certain regions and countries contain very small or negligible quantities of natural petroleum, there have been attempts to produce petrol from
15 biologically renewable sources. However, the prior attempts to produce petrol from biological oils have rendered unsatisfactory results since any product similar to petroleum which has been obtained has suffered from undesirable qualities
20 which would prevent the product from being used in a petrol engine. In order for such a product to be of a sufficiently high quality to be used in a petrol engine, the product must meet certain minimum requirements, a partial list of which
25 includes a reasonable octane number, low corrosion tendency, distillation condition and purity (to prevent catalytic converter poisoning).

Thus, there exists a need for a process which can economically produce petrol
30 from biological compounds such that the petrol produced is of sufficient purity and high octane number so as to power modern automobiles containing engines with catalytic converters. There also exists a need for a replaceable source of petrol.

35 According to the present invention, there is a process for producing a petrol with an octane number greater than 90, which process comprises

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catalytically cracking a fatty acid glycerine ester with a catalyst having, in a carrier, Y zeolite alumina-silica in a crystalline form.

5 The carrier preferably comprises alumina or silica.

In a preferred embodiment, the present invention provides a process for producing a petrol with an octane number greater than 90, which process comprises: passing a fatty acid glycerine ester containing
10 mixture, wherein the fatty acid moiety contains from 6 to 36 carbon atoms, into a reaction chamber having a catalyst having, in a carrier, Y zeolite alumina-silica in a crystalline form; catalytically cracking the mixture at a temperature in the range from 350°C to
15 650°C, at an applied pressure lower than 10 kg/cm²; and then removing a cracked mixture containing a petrol from the reaction chamber.

In the process of the present invention fatty acid glycerine esters with either generally saturated or
20 unsaturated fatty acid moieties are satisfactory as a raw material. Therefore, hydrogenation is not required. A generally saturated glycerine ester may be obtained from a biological source, such as coconut oil, and an unsaturated glycerine ester may be obtained from
25 biological sources, such as physic nut oil. By utilizing such renewable sources, a supply of petrol may be produced in countries having no natural petroleum deposits. Further, according to the process of the present invention, the raw material required to
30 produce petrol is a renewable resource which will not be depleted over time.

Thus the present invention makes it possible to produce a petrol, suitable for use in motor engines, from biological materials.

35 According to the preferred embodiment of a process in accordance with the present invention, a glycerine ester mixture wherein the fatty acid moiety contains from 6 to 36 carbon atoms

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is catalytically cracked by a catalyst which contains Y zeolite alumina-silica in a carrier. The Y zeolite alumina-silica content of the catalyst is preferably in the range from 5 to 50 percent by weight, with a range of 10 to 30 percent by weight being more preferred. Preferably, when the catalyst is used in a moving bed reactor, the catalyst is in a powder form, whereas when the catalyst is used in a fixed bed reactor, the catalyst is shaped in a cylindrical or spherical shape. During the process of the present invention, the reaction pressure applied in the reaction bed is preferably less than 10 kg/cm². A pressure which is less than 2 kg/cm² will usually be satisfactory. The reaction temperature of the reaction bed is preferably in the range from 350°C to 650°C, a more preferred reaction temperature being in the range from 450°C to 550°C. The ratio of the catalyst weight to the glycerine ester weight for a moving bed reactor should be in the range from 3:1 to 12:1, with a preferred ratio being in the range from 8:1 to 10:1. For a fixed bed reactor, for every one to five parts by weight of the catalyst, one part by weight of the mixture ^{may be} fed per hour to the reaction chamber, with a preferred value of 1 to 3 parts by weight of the catalyst for every one part by weight of the mixture fed per hour. When the catalytic reaction takes place under the conditions noted above, gas, water and coke are all formed besides a low boiling point oil. Thereafter, the oil is distilled and the distillate is tested for its quality as a petrol in the temperature range from 25°C to 200°C after treatment by caustic soda.

The fatty acid glycerine ester may have

one, two or three fatty acid moieties per glycerine moiety.

The invention will be further illustrated in the working examples that follow. However, the following examples are provided for illustration only, and are not intended to limit the scope of the present invention.

EXAMPLE 1

In this example, the results of which are tabulated in the following Table, petrol was produced from unrefined coconut oil which contained generally saturated fatty acid glycerine ester. The catalytic cracking was performed inside a moving bed reaction chamber with a catalyst containing Y zeolite alumina-silica powder. After one run of cracking, the gasoline yield was 34 percent by weight with an octane number of 94. After also analyzing the distilled products, it was found that the petrol product was of sufficiently high quality, so as to power a motor engine, without further treatment. In a usual catalytic cracking reaction, the uncracked oil remaining after the first run would have to be re-cracked so as to increase the yield of the petrol.

EXAMPLE 2

In this example, the cracking run was performed under substantially the same conditions as stated in Example 1, except that hydrogenated coconut oil was utilized as the raw stock material. The hydrogenated coconut oil represented an example of highly saturated high grade fatty acid glycerine ester. The results of one run of catalytic cracking, which are set forth in the Table, were as good as the results obtained in Example 1.

EXAMPLE 3

In this example, physic nut oil was used as an example of an unsaturated fatty acid glycerine ester. The catalytic cracking was performed
5 on a fixed bed inside a reaction chamber, with cylindrically shaped catalytic particles (1.5mm diameter, 3mm length) containing Y zeolite alumina-silica, with a reaction temperature of approximately 500°C and for every 1.2 kilograms of catalyst,
10 one kilogram of physic nut oil was fed per hour.

When a physic nut oil was used on a moving bed reactor operated under conditions substantially similar to those stated in Example 1, a petrol of an octane number of 93 was obtained. After
15 analyzing the distilled products, it was found that the petrol product could be used as a fuel for a petrol motor engine after the product was subjected to a simple treatment with caustic soda to remove impurities.

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Comparison Example

For the purposes of comparison, a Middle East heavy gas oil was catalytically cracked under conditions substantially the same as those
25 stated in Example 1 above. In this comparison example, a moving bed was also utilized and the result was based upon one reaction run. The gasoline obtained had an octane number of 91.

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TABLE				
Example 1		Example 2		Example 3
Raw oil	coconut oil	hydrogenated coconut oil	physic nut oil	Middle East heavy gas oil
Component	saturated glycerine ester 91 wt. % unsaturated glycerine ester 8 wt. %	saturated glycerine ester 98 wt. % unsaturated glycerine ester 2 wt. %	saturated glycerine ester 77 wt. % unsaturated glycerine ester 23 wt. %	aromatic hydrocarbon and saturated hydrocarbons
Boiling Point (°C)	290 - 552	338 - 549	356 - 562	300 - 500
Catalytic Bed	moving bed	moving bed	moving bed	moving bed
Catalytic Agent	Y zeolite silica alumina	Y zeolite silica alumina	Y zeolite silica alumina	Y zeolite silica alumina
Reaction Temperature (°C)	485	500	500	485
Reaction Pressure (kg/cm ² @ 37.8°C)	normal	normal	normal	normal
Petrol Yield (weight percent)	34	35	35	50

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TABLE (Continued)

Example 1		Example 2		Example 3		Comparison Example	
Octane Number (research method)	94	92	91	93	91	91	91
Reaction (pH)	neutral	neutral	neutral	neutral	neutral	neutral	neutral
Distillation Conditions: 10% Distillation Temperature (°C)	34	35	38	40	48	48	48
50% Distillation Temperature (°C)	81	83	96	95	102.5	102.5	102.5
90% Distillation Temperature (°C)	167	166	154.5	155	191	191	191
97% Distillation Temperature (°C)	192	194	187	190	214.5	214.5	214.5
Residue Oils (Vol. %)	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Copper strip corrosion (3h @ 50°C)	1 b	1 a	1 a	1 a	1 a	1 a	1 a
Vapour Pressure (kg/cm ² @ 37.8°C)	0.72	0.69	0.54	0.57	0/51	0/51	0/51
Existent Gum (mg/100ml)	0.64	0.67	0.72	0.65	0.82	0.82	0.82
Tetra Ethyl Lead ml/l	0.0	0.0	0.0	0.0	0.0	0.0	0.0

*"1a and 1b" are Copper Corrosion Grades expressed in "Testing Method for Copper Corrosion of petroleum products" of the Japanese Industrial Standard K 2513 (JIS K 2513). In JIS, the grade of discolouration is expressed in the range from 1a to 4c. 1a is light orange, 1b is dark orange and 4c is black lustre.



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CLAIMS

1. A process for producing a petrol with an octane number greater than 90, which process comprises catalytically cracking a fatty acid glycerine ester with a catalyst having, in a carrier, Y zeolite alumina-silica in a crystalline form.
2. A process according to Claim 1, wherein the carrier comprises alumina.
3. A process according to Claim 1, wherein the carrier comprises silica.
4. A process for producing a petrol with an octane number greater than 90, which process comprises: passing a fatty acid glycerine ester containing mixture, wherein the fatty acid moiety contains from 6 to 36 carbon atoms, into a reaction chamber having a catalyst having, in a carrier, Y zeolite alumina-silica in a crystalline form; catalytically cracking the mixture at a temperature in the range from 350°C to 650°C, at an applied pressure lower than 10 kg/cm²; and then removing a cracked mixture containing a petrol from the reaction chamber.
5. A process according to Claim 4, wherein the catalyst in the reaction chamber is in the form of a moving bed and the catalyst is a powder.
6. A process according to Claim 5, wherein the weight ratio of catalyst to the glycerine ester is in the range from 3:1 to 12:1.
7. A process according to Claim 4, wherein the catalyst in the reaction chamber is in the form of a fixed bed, and the ^{particles of catalyst are} ~~catalyst is~~ shaped in the form of a cylinder.
8. A process according to Claim 4, wherein the catalyst in the reaction chamber is in the form of a fixed bed, and the ^{particles of catalyst are} ~~catalyst is~~ shaped in the form of a sphere.



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9. A process according to Claim 7 or 8, wherein, for every one to five parts by weight of the catalyst, one part by weight of the mixture is fed per hour to the reaction chamber.

5 10. A process according to any one of Claims 4 to 9, wherein the mixture contains a generally saturated glycerine ester.

10 11. A process according to Claim 10, wherein the ~~saturated~~^{mixture} glycerine ester is coconut oil.

12. A process according to any one of Claims 4 to 9, wherein the mixture contains an unsaturated glycerine ester.

15 13. A process according to Claim 12, wherein the ~~unsaturated~~^{mixture} glycerine ester is physic nut oil.

20 14. A process according to any one of Claims 4 to 13, wherein the Y zeolite alumina-silica constitutes from 5 to 50 percent by weight of the catalyst.

25 15. A process according to any one of Claims 4 to 14, which also includes treating the cracked mixture with an effective amount of a base to remove a sufficient quantity of impurities to enable the cracked mixture to be used as a fuel in an automobile petrol engine.

30 16. Petrol whenever produced by a process according to any preceding claim.