to provide a method for producing a biodiesel fuel whose main components are hydrocarbons, that is, a novel production method that can use a raw material containing at least one of a free fatty acid and a fatty acid glycerin ester.

[Means for solving the Problems]

[0008]

As a result of intensive studies to solve the above problems, the present inventor has found that a biodiesel fuel whose main components are hydrocarbons can be efficiently produced through adding an inorganic acid or enzyme to a raw material containing at least one of glycerin and a fatty acid glycerin ester to separate them and using the obtained oil component, or using a fatty acid alkyl ester obtained by further esterifying the oil component, to subject the above oil component or fatty acid alkyl ester to a catalytic cracking method. The present inventor has thus accomplished the present disclosure.

Specifically, the present disclosure is as follows.

[0008a]

In an aspect, there is provided a method for producing a biodiesel fuel, comprising:

a first separation step of reacting a raw material containing at least one of a free fatty acid and a fatty acid glycerin ester with an inorganic acid under the presence of a monohydric alcohol to separate a first oil component and a first glycerin liquid;

an esterification step of reacting the first oil component with a monohydric alcohol to obtain a fatty acid alkyl ester by using a method other than an alkali catalyst method, the method being at least one method selected from a group consisting of an acid catalyst method, an acid-

alkali catalyst method, a biocatalyst method, an ion-exchange resin method, a supercritical method, a subcritical method, and a solid catalyst method; and

a catalytic cracking step of bringing the fatty acid alkyl ester into contact with a catalyst to obtain a hydrocarbon,

wherein, in the reaction of the first separation step, a reaction liquid has a pH of 3 or less.

[0008b]

In another aspect, there is provided a method for producing a fatty acid alkyl ester, comprising:

a first separation step of reacting a raw material containing at least one of a free fatty acid and a fatty acid glycerin ester with an inorganic acid under the presence of a monohydric alcohol to separate a first oil component and a first glycerin liquid; and

an esterification step of reacting the first oil component with a monohydric alcohol to obtain a fatty acid alkyl ester by using a method other than an alkali catalyst method, the method being at least one method selected from a group consisting of an acid catalyst method, an acid-alkali catalyst method, a biocatalyst method, an ion-

exchange resin method, a supercritical method, a subcritical method, and a solid catalyst method,

wherein, in the reaction of the first separation step, a reaction liquid has a pH of 3 or less.

[0009]

(1) A method for producing a biodiesel fuel, comprising:

a first separation step of mixing a raw material containing at least one of a free fatty acid and a fatty acid glycerin ester with an inorganic acid or enzyme to separate a first oil component and a first glycerin liquid;

an esterification step of reacting the first oil component with a monohydric alcohol to obtain a fatty acid alkyl ester by using a method other than an alkali catalyst method, the method being at least one method selected from the group consisting of an acid catalyst method, an acid-alkali catalyst method, a biocatalyst method, an ion-exchange resin method, a supercritical method, a subcritical method, and a solid catalyst method; and

[Name of Document] Claims

1. A method for producing a biodiesel fuel, comprising:

a first separation step of reacting a raw material containing at least one of a free fatty acid and a fatty acid glycerin ester with an inorganic acid under the presence of a monohydric alcohol to separate a first oil component and a first glycerin liquid;

an esterification step of reacting the first oil component with a monohydric alcohol to obtain a fatty acid alkyl ester by using a method other than an alkali catalyst method, the method being at least one method selected from a group consisting of an acid catalyst method, an acid-alkali catalyst method, a biocatalyst method, an ion-exchange resin method, a supercritical method, a subcritical method, and a solid catalyst method; and

a catalytic cracking step of bringing the fatty acid alkyl ester into contact with a catalyst to obtain a hydrocarbon,

wherein, in the reaction of the first separation step, a reaction liquid has a pH of 3 or less.

2. The method according to claim 1, comprising:

a neutralization step of neutralizing, with an alkaline substance, the first glycerin liquid obtained by using the inorganic acid in the first separation step; and

a second separation step of separating a second oil component and a precipitated inorganic salt from the neutralized glycerin liquid,

wherein the esterification step includes reacting the second oil component together with the first oil component.

3. The method according to claim 1 or 2, comprising:

a neutralization step of neutralizing, with an alkaline substance, the first glycerin liquid obtained by using the inorganic acid in the first separation step;

a second separation step of separating a second oil component and a precipitated inorganic salt from the neutralized glycerin liquid; and

an alcohol separation step of separating a monohydric alcohol from the glycerin liquid from which the second oil component and the inorganic salt are separated,

wherein the monohydric alcohol separated in the alcohol separation step is used as the monohydric alcohol in the esterification step.

4. The method according to any one of claims 1 to 3, wherein the catalyst in the catalytic cracking step contains magnesium oxide.

5. The method according to any one of claims 1 to 4, wherein the catalytic cracking step includes performing a reaction in a rotating drum that is arranged in a state in which its axis of rotation is inclined with respect to a horizontal plane.

6. The method according to any one of claims 1 to 5, wherein a reaction temperature in the catalytic cracking step is 200°C to 600°C.

7. The method according to claim 6, wherein the reaction temperature is adjusted by electromagnetic induction heating.

8. A method for producing a fatty acid alkyl ester,

comprising:

a first separation step of reacting a raw material containing at least one of a free fatty acid and a fatty acid glycerin ester with an inorganic acid under the presence of a monohydric alcohol to separate a first oil component and a first glycerin liquid; and

an esterification step of reacting the first oil component with a monohydric alcohol to obtain a fatty acid alkyl ester by using a method other than an alkali catalyst method, the method being at least one method selected from a group consisting of an acid catalyst method, an acid-alkali catalyst method, a biocatalyst method, an ion-exchange resin method, a supercritical method, a subcritical method, and a solid catalyst method,

wherein, in the reaction of the first separation step, a reaction liquid has a pH of 3 or less.

9. The method according to any one of claims 1 to 8, wherein, in the reaction of the first separation step, a reaction time is 4 hour or more.

10. The method according to any one of claims 1 to 8, wherein the raw material in the first separation step contains at least one of a high acid value oil having an acid value of 10 mgKOH/g or more and waste glycerin produced as a by-product in a process of producing a fatty acid alkyl ester.

11. The method according to any one of claims 1 to 9, wherein the inorganic acid is concentrated sulfuric acid.

12. The method according to claim 8, wherein the method further comprises:

a neutralization step of neutralizing the first glycerin liquid with an alkaline substance; and

a second separation step of separating a second oil component and a precipitated inorganic salt from the neutralized glycerin liquid to obtain a purified glycerin.