CLAIMS

What is claimed is:

1. A method for co-production of an alkylbenzene product (12) and a biofuel (13) from a natural oil (14) comprising:

deoxygenating the natural oil to form a stream (20) comprising paraffins;

dehydrogenating a first portion (24) of the paraffins to provide mono-olefins (52);

alkylating benzene (54) with the mono-olefins under alkylation conditions to provide an alkylation effluent (60) comprising alkylbenzenes and benzene;

isolating the alkylbenzenes to provide the alkylbenzene product; and

processing a second portion (26) of the paraffins to form biofuel.

2. The method of claim 1 wherein a hydrogen stream (36) results from processing the first portion of the paraffins, and wherein the method further comprises recycling the hydrogen stream to support the deoxygenating step.

3. The method of claim 1 wherein processing the second portion of the paraffins includes isomerizing the second portion of the paraffins to form isoparaffins.

4. The method of claim 1 wherein di-olefins are provided by dehydrogenating the paraffins, and wherein the method further comprises selectively hydrogenating the di-olefins to form additional mono-olefins.

5. The method of claim 4 further comprising removing aromatics from the mono-olefins before alkylating.

6. The method of claim 1 wherein the natural oil comprises a first plurality of fatty acids having a first range of chain lengths and a second plurality of fatty acids having a second range of chain lengths; wherein first chain length paraffins and second chain length paraffins are formed by deoxygenating the natural oils;

wherein the first portion of the paraffins comprise the first chain length paraffins; and wherein the second portion of the paraffins comprises the second chain length paraffins; the method further comprising:

fractionating the stream to separate the first portion of paraffins from the second portion of paraffins before dehydrogenating.

7. The method of claim 1 wherein the natural oil comprises fatty acids with internal hydroxyl groups, and wherein deoxygenating the natural oil causes cleaving and provides the first portion of the paraffins and the second portion of the paraffins.

8. The method of claim 8 wherein the natural oil is castor oil consisting essentially of C_{18} fatty acids with hydroxyl groups at the carbon-12 position, wherein the first portion of the paraffins resulting from cleaving have C_{10} to C_{11} chains, and wherein the second portion of the paraffins resulting from cleaving have C_{17} to C_{18} chains.

9. A method for co-production of an alkylbenzene product (12) and a biofuel (13) from natural oil source triglycerides (14) comprising:

deoxygenating the triglycerides to form a stream (20) comprising water, carbon dioxide, propane, a first portion of paraffins (24), and a second portion of paraffins (26);

fractionating the stream to separate the first portion of paraffins and the second portion of paraffins;

dehydrogenating the first portion of paraffins to provide mono-olefins (52);

alkylating benzene (54) with the mono-olefins under alkylation conditions to provide an alkylation effluent (60) comprising alkylbenzenes and benzene;

isolating the alkylbenzenes to provide the alkylbenzene product; and

processing the second portion of paraffins to form biofuel.

10. A method for co-production of an alkylbenzene product (12) and biofuel (13) from a natural oil (14) comprising:

deoxygenating the natural oil with hydrogen (18) to form a stream comprising paraffins (20);

dehydrogenating a first portion of the paraffins (24) in the stream to provide mono-olefins (52) and hydrogen (36);

recycling the hydrogen to support deoxygenation of the natural oil;

alkylating benzene (54) with the mono-olefins under alkylation conditions to provide an alkylation effluent (60) comprising alkylbenzenes and benzene;

isolating the alkylbenzenes to provide the alkylbenzene product; and

processing a second portion of the paraffins (26) to form biofuel.

CLAIMS

1. A method for co-production of an alkylbenzene product and a biofuel from a natural oil comprising:

deoxygenating the natural oil to form a stream comprising paraffins;

dehydrogenating a first portion of the paraffins to provide mono-olefins;

alkylating benzene with the mono-olefins under alkylation conditions to provide an alkylation effluent comprising alkylbenzenes and benzene;

isolating the alkylbenzenes to provide the alkylbenzene product; and

isomerizing a second portion of the paraffins to form biofuel.

2. The method of claim 1 wherein a hydrogen stream results from processing the first portion of the paraffins, and wherein the method further comprises recycling the hydrogen stream to support the deoxygenating step.

3. The method of claim 1 wherein the dehydrogenating the first portion of the paraffins further provides di-olefins, and wherein the method further comprises selectively hydrogenating the di-olefins to form additional mono-olefins.

4. The method of claim 3 wherein the dehydrogenating the first portion of the paraffins further provides aromatics, and wherein the method further comprising removing aromatics from the mono-olefins before alkylating.

5. The method of claim 1 wherein the natural oil comprises a first plurality of fatty acids having a first range of chain lengths and a second plurality of fatty acids having a second range of chain lengths; wherein first chain length paraffins and second chain length paraffins are formed by deoxygenating the natural oils;

wherein the first portion of the paraffins comprise the first chain length paraffins; and wherein the second portion of the paraffins comprises the second chain length paraffins; the method further comprising:

fractionating the stream to separate the first portion of paraffins from the second portion of paraffins before dehydrogenating.

6. The method of claim 1 wherein isolating provides the alkylbenzene product comprising alkylbenzenes having C_8 to C_{28} chains.

7. The method of claim 1 wherein the natural oil comprises fatty acids with internal hydroxyl groups, and wherein deoxygenating the natural oil causes cleaving and provides the first portion of the paraffins and the second portion of the paraffins.

8. The method of claim 7 wherein the natural oil is castor oil consisting essentially of C_{18} fatty acids with hydroxyl groups at the carbon-12 position.

9. The method of claim 8 wherein the first portion of the paraffins resulting from cleaving have C_{10} to C_{11} chains.

10. The method of claim 9 wherein the second portion of the paraffins resulting from cleaving have C_{17} to C_{18} chains.

11. A method for co-production of an alkylbenzene product and a biofuel from natural oil source triglycerides comprising:

deoxygenating the triglycerides to form a stream comprising water, carbon dioxide, propane, a first portion of paraffins, and a second portion of paraffins;

fractionating the stream to separate the first portion of paraffins and the second portion of paraffins;

dehydrogenating the first portion of paraffins to provide mono-olefins;

alkylating benzene with the mono-olefins under alkylation conditions to provide an alkylation effluent comprising alkylbenzenes and benzene;

isolating the alkylbenzenes to provide the alkylbenzene product; and

isomerizing the second portion of paraffins to form biofuel.

12. The method of claim 11 wherein a hydrogen stream results from processing the first portion of the paraffins, and wherein the method further comprises recycling the hydrogen stream to support the deoxygenating step.

13. The method of claim 11 wherein the dehydrogenating the first portion of paraffins further provides di-olefins, and wherein the method further comprises selectively hydrogenating the di-olefins to form additional mono-olefins for alkylating the benzene.

14. The method of claim 11 wherein the dehydrogenating the first portion of the paraffins further provides aromatics, and wherein the method further comprises removing aromatics from the mono-olefins before alkylating.

15. The method of claim 11 wherein:

the natural oil source is castor oil;

the triglycerides consist essentially of C_{18} fatty acids with hydroxyl groups at the carbon-12 position; and

deoxygenating the triglycerides causes cleaving and provides the first portion of paraffins and the second portion of paraffins.

16. The method of claim 15 wherein the first portion of paraffins have C_{10} to C_{11} chains.

17. The method of claim 16 wherein the second portion of paraffins have C_{17} to C_{18} chains.

18. A method for co-production of an alkylbenzene product and biofuel from a natural oil comprising:

deoxygenating the natural oil with hydrogen to form a stream comprising paraffins;

dehydrogenating a first portion of the paraffins in the stream to provide mono-olefins and hydrogen;

recycling the hydrogen to support deoxygenation of the natural oil;

alkylating benzene with the mono-olefins under alkylation conditions to provide an alkylation effluent comprising alkylbenzenes and benzene;

isolating the alkylbenzenes to provide the alkylbenzene product; and

isomerizing a second portion of the paraffins to form biofuel.

19. The method of claim 18 wherein a hydrogen stream results from processing the first portion of the paraffins, and wherein the method further comprises recycling the hydrogen stream to support the deoxygenating step.