Applications describing the process with a specific description of a recycle gas describes the gas loop as comprising a means of purification, such as an amine scrubber for removal of hydrogen sulfide and carbon oxides.

It has now been identified that the negative impact of carbon oxides on the deoxygenation process is less than expected, especially if using a catalyst not comprising cobalt, and therefore the provision of a process in which CO and CO_2 are present during deoxygenation is related to a significant cost reduction both in terms of investment and in terms of operation.

Summary

In one aspect of the present disclosure, there is provided a method for production of a hydrocarbon mixture from a feedstock stream comprising oxygenates and a make-up hydrogen gas stream, comprising the steps of directing a feed stream, comprising the feedstock stream comprising oxygenates, the make-up hydrogen gas stream and a hydrogen rich gas stream, to contact a material catalytically active in deoxygenation under active deoxygenation conditions and withdrawing a deoxygenated product stream, characterized in the hydrogen rich gas stream comprising at least 70% hydrogen, at least 0.1% carbon monoxide and at least 50 ppm H_2S, and characterized in said material catalytically active in deoxygenation comprising molybdenum and/or nickel, on a support of refractory material and comprising less than 0.1 wt% cobalt, without requiring a step of purifying said hydrogen rich gas stream by use of an amine wash.

In another aspect of the present disclosure, there is provided a process plant section for conversion of a feedstock stream comprising oxygenates to a hydrocarbon mixture, comprising a deoxygenation reactor having an inlet and an outlet, a separation section having an inlet and a gas outlet, an aqueous phase outlet and a hydrocarbon phase outlet, wherein said deoxygenation reactor inlet is configured for receiving said feedstock and a recycled hydrogen rich gas stream, said separator is configured for receiving a deoxygenated product stream from said deoxygenation reactor outlet, and the separation section gas outlet is configured for providing said recycled hydrogen rich

gas stream, characterized in said process plant section not comprising an amine scrubber configured for treating the stream of the separation section gas outlet, characterized in the hydrogen rich gas stream comprising at least 70% hydrogen, at least 0.1% carbon monoxide and at least 50 ppm H_2S, and wherein the deoxygenation reactor comprises a material catalytically active in deoxygenation under active deoxygenation conditions, characterized in said material catalytically active in deoxygenation comprising molybdenum and/or nickel, on a support of refractory material and comprising less than 0.1 wt% cobalt.

Description

In the following the term deoxygenation shall be used to signify removal of oxygen from oxygenates by formation of water in the presence of hydrogen (also known as hydrodeoxygenation), as well as removal of oxygen from oxygenates by formation of carbon oxides in the presence of hydrogen (also known as decarboxylation).

In the following the term active deoxygenation conditions shall be used to signify conditions under which at least 10% conversion by deoxygenation shall take place.

In the following where concentrations (typically in liquid or solid phase) are stated in wt% this shall be understood as weight/weight %.

In the following where concentrations in the gas phase are stated, they are, unless otherwise specified given as molar (volumetric) concentration, e.g. vol% or ppm_{vol}.

A broad aspect of the present disclosure relate to a method for production of a hydrocarbon mixture from a feedstock stream comprising oxygenates and a make-up hydrogen gas stream, comprising the steps of directing a feed stream, comprising the feedstock stream comprising oxygenates, the make-up hydrogen gas stream and a hydrogen rich gas stream, to contact a material catalytically active in deoxygenation under active deoxygenation conditions and withdrawing a deoxygenated product stream, characterized in the hydrogen rich gas stream comprising at least 70 vol% hydrogen, at least 0.1 vol% carbon oxides and at least 50 ppm_{vol} H_2S, with the associated benefit that such a method, where carbon oxides are allowed to be present may be realized without requiring a step of purifying said recycled hydrogen rich gas stream, e.g. by use of an amine wash.

Claims

1. A method for production of a hydrocarbon mixture from a feedstock stream comprising oxygenates and a make-up hydrogen gas stream, comprising the steps of directing a feed stream, comprising the feedstock stream comprising oxygenates, the make-up hydrogen gas stream and a hydrogen rich gas stream, to contact a material catalytically active in deoxygenation under active deoxygenation conditions and withdrawing a deoxygenated product stream, characterized in the hydrogen rich gas stream comprising at least 70% hydrogen, at least 0.1% carbon monoxide and at least 50 ppm H_2S, and characterized in said material catalytically active in deoxygenation comprising molybdenum and/or nickel, on a support of refractory material and comprising less than 0.1 wt% cobalt, without requiring a step of purifying said hydrogen rich gas stream by use of an amine wash.

2. A method according to claim 1 further characterized in the hydrogen rich gas stream comprising at least 0.1% carbon dioxide.

3. The method according to claim 1 or 2, wherein said feedstock stream comprising oxygenates, comprises a fresh feedstock rich in oxygenates and a diluent, said diluent being a further feedstock or a recycled liquid stream.

4. The method according to claim 3 further characterized in said liquid diluent comprising less than 0.1 wt% atomic oxygen.

5. The method according to claim 3 or 4 wherein said liquid diluent comprises an amount of said deoxygenated product stream or comprises an amount of a product from a process step receiving an amount of said deoxygenated product stream.

6. The method according to claim 3, 4 or 5 further characterized in said liquid diluent being a stream comprising fossil feedstock.

7. The method according to claim 1, 2, 3, 4, 5 or 6 further characterized in the amount of sulfur contained in said hydrogen rich gas stream relative to the amount of sulfur in the gas phase of the combined feed stream is at least 40%, 60% or 80%.

8. The method according to claim 1, 2, 3, 4, 5, 6 or 7 further characterized in at least an amount of said deoxygenated product stream being directed to contact a material catalytically active in hydrocracking and/or hydroisomerization under active hydrocracking and/or hydroisomerization conditions and withdrawing a further treated product stream.

9. The method according to claim 8 wherein said deoxygenated product stream or said further treated product stream is separated in a gas stream and a liquid stream, and wherein said hydrogen rich gas stream comprises a recycled amount of said gas stream.

10. The method according to claim 1, 2, 3, 4, 5, 6, 7, 8 or 9 wherein less than 50 vol%, such as less than 10 vol%, less than 1 vol% or 0 vol%, of the carbon oxides in the recycled amount of said gas stream are removed prior to the recycled amount of said gas stream being directed to contact said material catalytically active in deoxygenation.

11. The method according to claim 10, wherein said carbon oxides are removed from the gas stream by a process involving membrane separation or by withdrawal of a purge gas stream.

12. The method according to claim 10 or 11, wherein said removal of carbon oxides does not involve scrubbing of the gas stream.

13. A process plant section for conversion of a feedstock stream comprising oxygenates to a hydrocarbon mixture, comprising a deoxygenation reactor having an inlet and an outlet, a separation section having an inlet and a gas outlet, an aqueous phase outlet and a hydrocarbon phase outlet, wherein said deoxygenation reactor inlet is configured for receiving said feedstock and a

recycled hydrogen rich gas stream, said separator is configured for receiving a deoxygenated product stream from said deoxygenation reactor outlet, and the separation section gas outlet is configured for providing said recycled hydrogen rich gas stream, characterized in said process plant section not comprising an amine scrubber configured for treating the stream of the separation section gas outlet, characterized in the hydrogen rich gas stream comprising at least 70% hydrogen, at least 0.1% carbon monoxide and at least 50 ppm H_2S, and wherein the deoxygenation reactor comprises a material catalytically active in deoxygenation under active deoxygenation conditions, characterized in said material catalytically active in deoxygenation comprising molybdenum and/or nickel, on a support of refractory material and comprising less than 0.1 wt% cobalt.