It is characteristic of the HDO and HDW catalysts used in the present invention that sulfur has to be present to maintain the catalytic activity of the catalysts. The zeolite in the HDW catalyst may be selected from the ones not sensitive to poisoning by low levels of sulfur. The catalysts are typically sulfided before start up by adding sulfur containing compound(s) such as hydrogen sulphide or dimethyl disulphide. Additional sulfur during operation is needed only in case the concentration of organic sulfur in the feed material is too low. When CTO is used as the feed material, additional sulfur is generally not needed to maintain the catalytic activity of the HDO and HDW catalysts. When additional sulfur is needed, suitable sulfur compound may be added to the feed. Further, the first recycle stream may also contain sulfur, which may be used for maintaining the catalytic activity of the HDO and HDW catalysts.

The amount of hydrogen gas needed for the various hydroprocessing reactions depends on the amount and type of the feed material, as well as on the process conditions. Feedstock originating from renewable sources, such as oil, fat and wax typically contains fatty acids and/or triglyceride structures, which are hydrogenated and cracked in the hydrotreatment reaction forming water and long paraffinic carbon chains.

CTO is a feedstock of biological origin, which lacks triglyceride structures but contains fatty acids and other oxygen containing compounds as well as aromatics and olefinic compounds requiring hydrogen for conversion into fuel components.

In the catalytic hydroprocessing the hydrogen partial pressure is maintained in the range from 50 to 250 bar, suitably from 80 to 200 bar, particularly suitably from 80 to 110 bar. The total pressure in the hydroprocessing is from 50 to 250 bar, suitably from 80 to 120 bar.

In an embodiment, the hydrogen partial pressure in the catalytic hydroprocessing is in the range from 25 to 250 bar, preferably from 60 to 200 bar, particularly preferably from 80 to 150 bar.

In an embodiment, the total pressure in the catalytic hydroprocessing is from 25 to 250 bar, preferably from 80 to 160 bar.

Hydrogen is supplied to the catalytic hydroprocessing from the hydrogen plant and part of the hydrogen is obtained with the first recycle stream originating from the hydroprocessing reactor, said first recycle stream comprising additionally light hydrocarbons (C1 – C5). Methane tends to accumulate in the recycle hydrogen stream, as well as the other light hydrocarbons. In the process hydrogen stream (stream 1 in figure 1) and the first recycle stream, (stream 4 in figure 1) are combined to form combined stream (stream 6 in figure 1). The light hydrocarbons and carbon monoxide possibly present in said combined stream decrease the hydrogen partial pressure in the stream and consequently also in the hydroprocessing reactor. In the present process the concentration of light hydrocarbons and CO in the combined stream is suitably adjusted

Claims

1. An integrated process for producing hydrocarbons, said process comprising the steps of subjecting feedstock originating from renewable sources to catalytic hydroprocessing in a hydroprocessing system in the presence of hydrogen, followed by separation of an aqueous component, a heavy component comprising hydrocarbons having carbon number more than 5, and a light component comprising gases and hydrocarbons having carbon number from 1 to 5, directing said light component to separation for removal of carbon dioxide and hydrogen sulfide to obtain a recycle stream comprising hydrogen and hydrocarbons having carbon number from 1 to 5, followed by dividing the recycle stream to a first recycle stream and a second recycle stream, directing the first recycle stream to the hydroprocessing system, and the second recycle stream to a hydrogen plant comprising a steam reformer unit, a desulfurization unit upstream the steam reformer unit, and water gas shift unit, converting said hydrocarbons having carbon number from 1 to 5 in said hydrogen plant to hydrogen, and directing a hydrogen stream comprising said hydrogen to the hydroprocessing system, wherein the hydrogen partial pressure in the catalytic hydroprocessing is in the range from 25 to 250 bar.

2. The integrated process for producing hydrocarbons according to claim 1, wherein natural gas, LPG, naphta, biogas, methane, ethane, propane, butane or a combination thereof is used as starting material to the hydrogen plant.

3. The integrated process for producing hydrocarbons according to claim 2, wherein the second recycle stream is directed to the desulfurization unit of the hydrogen plant and sulfur compounds are removed from the starting material.

4. The integrated process for producing hydrocarbons according to any one of claims 1 - 3, wherein the hydrogen plant comprises additionally a carbon dioxide/carbon monoxide/water separator unit.

5. The integrated process for producing hydrocarbons according to any one of claims 1-4, wherein the first recycle stream is combined with the hydrogen stream to obtain a combined stream, and the amount of hydrocarbons having carbon number from 1 to 5 in the combined stream is adjusted to the range not more than 30 % by mole, calculated from the total amount of feedstock to the hydroprocessing system.

15. An integrated process for converting hydrocarbons having carbon number from 1 to 5 to hydrogen, wherein said process comprises the steps where feedstock originating from renewable sources is subjected to catalytic hydroprocessing in a hydroprocessing system in the presence of hydrogen, followed by separation of an aqueous component, a heavy component comprising hydrocarbons having carbon number more than 5, and a light component comprising gases and hydrocarbons having carbon number from 1 to 5, directing said light component to separation for removal of carbon dioxide and hydrogen sulfide to obtain a recycle stream comprising hydrogen and hydrocarbons having carbon number from 1 to 5, followed by dividing the recycle stream to a first recycle stream and a second recycle stream, directing the first recycle stream to the hydroprocessing system, and the second recycle stream to a hydrogen plant comprising a steam reformer unit, a desulfurization unit upstream the steam reformer unit, and water gas shift unit, and converting said hydrocarbons having carbon number from 1 to 5 in said hydrogen plant to hydrogen.

16. The integrated process for converting hydrocarbons having carbon number from 1 to 5 to hydrogen according to claim 15, wherein hydrogen stream comprising said hydrogen converted in said hydrogen plant is directed to the hydroprocessing system.

17. The integrated process for converting hydrocarbons having carbon number from 1 to 5 to hydrogen according to claim 15 or 16, wherein natural gas, LPG, naphta, biogas, methane, ethane, propane, butane or a combination thereof is used as starting material to the hydrogen plant.

18. The integrated process for converting hydrocarbons having carbon number from 1 to 5 to hydrogen according to claim 17, wherein the second recycle stream is directed to the desulfurization unit of the hydrogen plant and sulfur compounds are removed from the starting material.

19. The integrated process for converting hydrocarbons having carbon number from 1 to 5 to hydrogen according to any one of claims 15 - 18, wherein the hydrogen plant comprises additionally carbon dioxide/carbon monoxide/water separator unit.

20. The integrated process for converting hydrocarbons having carbon number from 1 to 5 to hydrogen according to any one of claims 15 - 19, wherein the light component is subjected to separation using one or more amine scrubbers capable of removing hydrogen sulfide and carbon dioxide.

21. The integrated process for converting hydrocarbons having carbon number from 1 to 5 to hydrogen according to any one of claims 15 - 20, wherein the feedstock originating from renewable source is selected from feedstock originating from plants, animals, algae, fish, microbiological processes, side streams and waste streams originating from processing said feedstocks, and sewage sludge.

22. The integrated process for converting hydrocarbons having carbon number from 1 to 5 to hydrogen according to any one of claims 15 - 21, wherein the feedstock comprises plant oil, or compounds which are obtained as a by-product from the forest industry, and combinations thereof.