accordance with the practice in the art, be understood as equipment operating at pressures closer to process pressure than to ambient pressure. Similar “low pressure” in this context shall be understood as closer to ambient pressure than process pressure.

Summary

In a first aspect of the present disclosure, there is provided a process for conversion of a feedstock rich in oxygenates to a liquid product stream of hydrocarbons comprising the steps of

a. directing said feedstock in combination with a recycle gas stream to a hydroprocessing step, to provide a two-phase hydroprocessed process stream comprising at least hydrogen, methane and hydrocarbons,
b. combining a methane lean stream of hydrocarbons being liquid at ambient temperature and pressure, with a methane donor stream being either (i) said two-phase hydroprocessed process stream or (ii) a gaseous hydroprocessed stream derived from the two-phase hydroprocessed process stream by a means of phase separation, and optionally cooling, to provide a multiple-phase combined stream,
c. separating said multiple-phase combined stream in at least a hydrogen rich gas stream comprising a majority of the hydrogen comprised in said hydroprocessed process stream and a rich liquid hydrocarbon stream comprising absorbed methane,
d. in a desorption step desorbing an amount of methane from said rich liquid hydrocarbon stream such as by a flashing process or by a stripping process, in order to transfer an amount of methane to the gas phase, in order to provide a methane rich gaseous stream, and in order to provide a liquid product stream of hydrocarbons.

In another aspect of the present disclosure, there is provided a process plant comprising

a hydroprocessing section having a liquid phase inlet, a gas phase inlet and an outlet,
a first means of separation having an inlet, a liquid phase outlet and a gas phase outlet,
a means of absorption, having a liquid inlet and a gas phase inlet, a liquid phase outlet and a gas phase outlet, optionally in an integrated device in the same pressure vessel

as said first means of separation such that by the gas phase outlet of the first means of separation, the gas phase inlet of the means of absorption and the liquid phase outlet of the means of absorption are internal to the integrated device,

a second means of separation having an inlet, a liquid phase outlet and a gas phase outlet,

wherein the liquid phase inlet of the hydroprocessing section is configured to receive an oxygenate feedstock,

the gas phase inlet of the hydroprocessing section is configured to receive a gas rich in hydrogen, and the outlet of the hydroprocessing section is in fluid communication with the inlet of the first means of separation,

the gas phase outlet of the first means of separation is in fluid communication with the gas phase inlet of the means of absorption,

a liquid hydrocarbon stream is directed to said liquid phase inlet of the means of absorption and

the gas phase outlet of the means of absorption is in fluid communication with said gas phase inlet of the hydroprocessing section, optionally via a means of purification,

the liquid phase outlet of the means of absorption is in fluid communication with the inlet of said second means of separation.

In a further aspect of the present disclosure, there is provided an integrated means of separation and absorption comprising a multiple phase stream inlet, a liquid phase inlet, a liquid phase outlet and a gas phase outlet,

said integrated means of separation and absorption comprising a separation zone and an absorption zone in a single pressure vessel,

wherein said separation zone is positioned below said absorption zone and configured to allow fluid communication between the separation zone and the absorption zone, and wherein said absorption zone, has a liquid inlet and a gas phase outlet, and optionally comprises means for enhancing the contact between gas and liquid.

Description

A broad aspect of the present disclosure relates to a process for conversion of a feedstock rich in oxygenates to a liquid product stream of hydrocarbons comprising the steps of directing said feedstock in combination with a recycle gas stream to a hydroprocessing step, to provide a two-phase hydroprocessed process stream comprising at least hydrogen, methane and hydrocarbons, combining a methane lean stream of hydrocarbons being liquid at ambient temperature and pressure, with a methane donor stream being either (i) said two-phase hydroprocessed process stream or (ii) a gaseous hydroprocessed stream derived from the two-phase hydroprocessed process stream by phase separation, to provide a multiple-phase combined stream, separating said multiple-phase combined stream in at least a hydrogen rich gas stream comprising a majority of the hydrogen comprised in said hydroprocessed process stream and a rich liquid hydrocarbon stream comprising absorbed methane, in a desorption step desorbing an amount of methane from said rich liquid hydrocarbon stream such as by a flashing process or by a stripping process, in order to transfer an amount of methane to the gas phase, in order to provide a methane rich gaseous stream, and in order to provide a liquid product stream of hydrocarbons. The transfer of methane may be to a methane rich gas phase which has a higher concentration of methane than the gas phase of the methane donor stream or it may be to another stream. The liquid hydrocarbon stream will have an increased capacity for absorbing methane, compared to the rich liquid hydrocarbon stream. This has the associated benefit of such a process being efficient in reducing the amount of methane in the recycle gas stream, which enables an increased partial pressure of hydrogen by facilitating release of methane in a separate stream. The increased partial pressure of hydrogen is beneficial for the hydroprocessing reactions, which may increase selectivity and reaction rate with an increased partial pressure of hydrogen. The capacity of the liquid stream of hydrocarbons for dissolving methane will be defined by the nature of the stream, the amount of methane and other gases contained therein and the physical conditions such as pressure and temperature. The process involves provision of a capacity for absorbing methane in a methane lean stream of hydrocarbons by contacting this stream