Title: Process for operating sulfided hydroprocessing catalyst

The present invention relates to a process for operating a process involving a sulfided material catalytically active in hydroprocessing, especially when treating a feedstock comprising low amounts of sulfur.

The upgrading of fossil feedstocks typically involves hydroprocessing in the presence of a catalytically active material comprising sulfided base metals, typically molybdenum or tungsten often in combination with nickel or cobalt. Sulfided base metals are used as they are less expensive and more robust in operation compared to noble metals, which operate in a reduced, sulfur-free, state. As a typical objective of hydroprocessing of fossil feedstocks is the removal of sulfur from the feedstock, maintaining these base metals in the sulfided state has not been a problem.

However, when treating feedstocks with extremely low sulfur content such as many renewable feedstocks and synthetic hydrocarbons this continuous maintenance of the active state of catalytically active materials is not available. As these feedstocks are of high relevance, especially with respect to reducing climate change, it is important to handle this issue. One way of doing this is by providing a sufficient amount of sulfur, either by addition of a sulfiding agent such as di-methyl di-sulfide (DMDS) or by addition of an amount of feedstock comprising sulfur, such as fossil feedstock. However, since sulfur is undesired in the product, such added sulfur must also be removed, e.g. after capture on an adsorbent or in an amine wash.

Summary

In an aspect of the present disclosure, there is provided a process for hydroprocessing of a hydrocarbonaceous feedstock stream comprising the steps of:

a. directing said hydrocarbonaceous feedstock stream and a source of sulfur to contact a material catalytically active in hydroprocessing thus providing a hydroprocessed stream;

b. cooling said hydroprocessed stream to produce a three-phase hydroprocessed stream and separating said three-phase hydroprocessed stream in a purified hydrocarbon stream, sour water and a separation off-gas;
c. separating said sour water in a purified water stream and sour stream;
d. directing one or both of said sour stream or said separation off-gas as a sulfur source for step a, either directly or after separation it to contact said material catalytically active in hydroprocessing or to be combined by combination with said hydroprocessed stream prior to step b;

said material catalytically active in hydroprocessing comprising at least one base metal from Group 5, 8, 9 or 10 of the periodic table in sulfided state.

In another aspect of the present disclosure, there is provided a process plant comprising
a hydroprocessing reactor, having an inlet and an outlet,
a first product separation section configured for separation of a product in three phases, having an inlet, a gas outlet, a non-polar liquid outlet and a polar liquid outlet,
a second product separation section configured for separation of a product in three phases, having an inlet, a gas outlet, a purified hydrocarbon outlet and a sour water outlet,
a sour water separation section, having an inlet, a gas outlet, a purified water outlet and a sour water condensate outlet,
wherein said hydroprocessing reactor outlet is in fluid communication with the first product separation section inlet,
wherein the first product separation section gas outlet is in fluid communication with the hydroprocessing reactor inlet,
wherein the first product separation section non-polar liquid outlet is in fluid communication with the second product separation section inlet,
wherein said polar liquid outlet and said sour water outlet are in fluid communication with the sour water separation section inlet,
wherein the sour water condensate outlet is in fluid communication with either the inlet of said hydroprocessing reactor, or with said first product separation section inlet,
and wherein the process plant is configured for directing a feedstock to the

Claims:

1. A process for hydroprocessing of a hydrocarbonaceous feedstock stream comprising the steps of:
    a. directing said hydrocarbonaceous feedstock stream and a source of sulfur to contact a material catalytically active in hydroprocessing thus providing a hydroprocessed stream;
    b. cooling said hydroprocessed stream to produce a three-phase hydroprocessed stream and separating said three-phase hydroprocessed stream in a purified hydrocarbon stream, sour water and a separation off-gas;
    c. separating said sour water in a purified water stream and sour stream;
    d. directing one or both of said sour stream or said separation off-gas as a sulfur source for step a, either directly or after separation it to contact said material catalytically active in hydroprocessing or to be combined by combination with said hydroprocessed stream prior to step b;

    said material catalytically active in hydroprocessing comprising at least one base metal from Group 5, 8, 9 or 10 of the periodic table in sulfided state.

2. A process according to claim 1, wherein said hydrocarbonaceous feedstock stream comprises less than 300 ppm_w sulfur.

3. A process according to claim 1, wherein said hydrocarbonaceous feedstock is a feedstock rich in oxygenates, comprising from at least 1 wt% O on elemental basis.

4. A process according to claim 1, wherein said hydrocarbonaceous feedstock is a synthetic hydrocarbonaceous feedstock, such as a product of a Fischer-Tropsch process comprising from 1 wt% to 20 wt% O in alcohols, and at least 80% molecules having a non-branched carbon skeleton structure or a product of a process synthesizing hydrocarbons from reactive oxygenates, comprising at least 20% monoaromatics, and where the ratio of 1,2,4-trimethyl benzene to 1,2,3-trimethyl benzene is above 6:1.

5. A process according to claim 1, wherein said step b) involves a product stripping process, wherein a first stripping medium is directed to contact the hydroprocessed stream to provide a stripped product and a product stripper off-gas.

6. A process according to claim 5, wherein the first stripping medium is taken from the group comprising hydrogen, steam and reboiled hydroprocessed stream.

7. A process according to claim 1, wherein step c) involves a sour water stripping process, wherein a second stripping medium is directed to contact the sour water.

8. A process according to claim 7, wherein the second stripping medium is either steam or reboiled sour water.

9. A process according to claim 1, wherein said sour stream further comprises one or more streams comprising sulfur, such as washing water from washing said separation off-gas, a purge gas and/or a H_2 rich gas.

10. A process according to claim 7, wherein said sour water stripping process involves condensing the sour water stripper off-gas by cooling to provide a sour water condensate and directing an amount of said sour water condensate as liquid sour recycle and directing an amount of said sour water condensate as reflux for the stripping process.

11. A process according to claim 5, wherein said product stripping process involves condensing the product stripper off-gas by cooling, directing an amount of basic aqueous solution to contact said cooled product stripper off-gas to provide a polar product stripper condensate and a non-polar product stripper condensate and directing the polar product stripper condensate to be combined with said sour water.

12. A process plant comprising
a hydroprocessing reactor, having an inlet and an outlet,
a first product separation section configured for separation of a product in three phases, having an inlet, a gas outlet, a non-polar liquid outlet and a polar liquid outlet,
a second product separation section configured for separation of a product in three phases, having an inlet, a gas outlet, a purified hydrocarbon outlet and a sour water outlet,

a sour water separation section, having an inlet, a gas outlet, a purified water outlet and a sour water condensate outlet,
wherein said hydroprocessing reactor outlet is in fluid communication with the first product separation section inlet,
wherein the first product separation section gas outlet is in fluid communication with the hydroprocessing reactor inlet,
wherein the first product separation section non-polar liquid outlet is in fluid communication with the second product separation section inlet,
wherein said polar liquid outlet and said sour water outlet are in fluid communication with the sour water separation section inlet,
wherein the sour water condensate outlet is in fluid communication with either the inlet of said hydroprocessing reactor, or with said first product separation section inlet,
and wherein the process plant is configured for directing a feedstock to the hydroprocessing reactor inlet and configured for withdrawing a purified hydrocarbon from said purified hydrocarbon outlet.

13. A process according to claim 1, wherein step d comprises directing said sour stream as the sulfur source for step a.