streams that fail to meet specifications. The presence of acetylene in product streams may cause additional problems in downstream processes utilizing these ethylene product streams.

[0007] The methods disclosed herein for operating an acetylene hydrogenation unit in an olefin production process may reduce or prevent acetylene breakthrough and/or thermal runaway by changing the operating conditions of the acetylene hydrogenation unit in response to changes in the hydrogen concentration in the acetylene hydrogenation unit or the streams fed thereto. In particular, in one or more examples presently described, the methods may include determining the hydrogen concentration in the acetylene hydrogenation unit or the hydrogenation feed and modifying the temperature, the carbon monoxide (CO) concentration, or both, in the acetylene hydrogenation unit to meet the desired acetylene target concentrations without risk of reactor runaway or breakthrough of acetylene to downstream processes. It has been discovered that modifying the temperature of the acetylene hydrogenation unit and/or the CO concentration in the acetylene hydrogenation unit shifts operation of the acetylene hydrogenation unit with respect to acetylene conversion and ethylene selectivity, which may be leveraged to reduce the probability of thermal runaway or breakthrough of the acetylene to downstream processes. The inlet temperature of the acetylene hydrogenation unit may be increased or decreased by increasing or decreasing the temperature of the hydrogenation feed introduced to the acetylene hydrogenation unit, such as by changing the amount of heat transferred to the hydrogenation feed before passing it into the acetylene hydrogenation unit. The CO concentration in the acetylene hydrogenation unit may be increased or decreased by changing the operating conditions of the steam cracking unit or the concentration of sulfur-containing compounds in the steam cracking unit upstream of the acetylene hydrogenation unit. Supplemental CO may also be added to the hydrogenation feed before passing the hydrogenation feed to the acetylene hydrogenation unit. Accordingly, there is an ongoing need for processes for operating acetylene hydrogenation units in olefin production processes that enable frequent changes in the composition of the feedstock introduced to the olefin production process while preventing thermal runaway of the acetylene hydrogenation unit.

[0008] According to one example presently described, a method for selectively hydrogenating acetylene in a cracked gas from a steam cracking unit for producing olefins may include separating a hydrogenation feed from the cracked gas. The hydrogenation feed may include acetylene, hydrogen, carbon monoxide, and at least one product (e.g., at least one olefin product). The method may further include contacting the hydrogenation feed with an acetylene hydrogenation catalyst, the contacting causing hydrogenation of at least a portion of the acetylene

of the hydrogenation feed to produce a hydrogenation effluent. In response to a change in a composition of a feedstock to the steam cracking unit that results in a change in a hydrogen concentration in the hydrogenation feed, the method may further include determining the hydrogen concentration in the hydrogenation feed and increasing or decreasing a temperature of the hydrogenation feed based on the determined hydrogen concentration of the hydrogenation feed.

[0008a] In one aspect, the present disclosure refers to a method for selectively hydrogenating acetylene in a cracked gas from a steam cracking unit for producing olefins, the method comprising:

separating a hydrogenation feed from the cracked gas, the hydrogenation feed comprising acetylene, hydrogen, carbon monoxide, and at least one product;

contacting the hydrogenation feed with an acetylene hydrogenation catalyst, the contacting causing hydrogenation of at least a portion of the acetylene of the hydrogenation feed to produce a hydrogenation effluent;

in response to a change in a composition of a feedstock to the steam cracking unit that results in a change in a hydrogen concentration in the hydrogenation feed, determining the hydrogen concentration in the hydrogenation feed; and

increasing or decreasing a temperature of the hydrogenation feed based on the determined hydrogen concentration of the hydrogenation feed.

[0009] According to another example presently described, a method for operating an acetylene hydrogenation unit in an olefin production system may include cracking at least a portion of a feedstock in a steam cracking unit to produce a cracked gas. The feedstock may include one or more hydrocarbons. The method may further include passing at least a portion of the cracked gas to a separation system operable to produce at least a hydrogenation feed from the cracked gas. The hydrogenation feed may include at least acetylene, carbon monoxide, hydrogen, and at least one product (e.g., at least one olefin product). The method may further include contacting the hydrogenation feed with an acetylene hydrogenation catalyst in an acetylene hydrogenation unit, the contacting causing hydrogenation of at least a portion of the acetylene in the hydrogenation feed to produce a hydrogenation effluent. The method may further include changing a composition of the feedstock cracked in the steam cracking unit. Changing the composition of the feedstock may increase or decrease a hydrogen concentration in the hydrogenation feed. The method may further include, in response to changing the composition of

the feedstock, determining the hydrogen concentration in the acetylene hydrogenation unit and increasing or decreasing a temperature of the acetylene hydrogenation unit based on the determination of the hydrogen concentration in the acetylene hydrogenation unit.

[0009a] In another aspect, the present disclosure refers to a method for operating an acetylene hydrogenation unit in an olefin production system, the process comprising:

cracking at least a portion of a feedstock in a steam cracking unit to produce a cracked gas, the feedstock comprising one or more hydrocarbons;

passing at least a portion of the cracked gas to a separation system operable to produce at least a hydrogenation feed from the cracked gas, the hydrogenation feed comprising acetylene, carbon monoxide, hydrogen, and at least one product;

contacting the hydrogenation feed with an acetylene hydrogenation catalyst in an acetylene hydrogenation unit, the contacting causing hydrogenation of at least a portion of the acetylene in the hydrogenation feed to produce a hydrogenation effluent;

changing a composition of the feedstock cracked in the steam cracking unit, wherein changing the composition of the feedstock increases or decreases a hydrogen concentration in the hydrogenation feed;

in response to changing the composition of the feedstock, determining the hydrogen concentration in the acetylene hydrogenation unit; and

increasing or decreasing a temperature of the acetylene hydrogenation unit based on the determination of the hydrogen concentration in the acetylene hydrogenation unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The following detailed description of specific embodiments of the present disclosure can be best understood when read in conjunction with the following drawings, where like structure is indicated with like reference numerals and in which:

[0011] FIG. 1 schematically depicts a process for producing olefins from a hydrocarbon feedstock, the process including a heat exchanger upstream of an acetylene hydrogenation unit, according to one or more embodiments shown an described herein;

CLAIMS

1. A method for selectively hydrogenating acetylene in a cracked gas from a steam cracking unit for producing olefins, the method comprising:

separating a hydrogenation feed from the cracked gas, the hydrogenation feed comprising acetylene, hydrogen, carbon monoxide, and at least one product;

contacting the hydrogenation feed with an acetylene hydrogenation catalyst, the contacting causing hydrogenation of at least a portion of the acetylene of the hydrogenation feed to produce a hydrogenation effluent;

in response to a change in a composition of a feedstock to the steam cracking unit that results in a change in a hydrogen concentration in the hydrogenation feed, determining the hydrogen concentration in the hydrogenation feed; and

increasing or decreasing a temperature of the hydrogenation feed based on the determined hydrogen concentration of the hydrogenation feed.

2. The method of claim 1, wherein determining the hydrogen concentration of the hydrogenation feed comprises measuring a concentration of hydrogen in the cracked gas, the hydrogenation feed, the hydrogenation effluent, or combinations thereof.

3. The method of either of claims 1 or 2, wherein increasing or decreasing the temperature of the hydrogenation feed comprises increasing or decreasing a temperature of the hydrogenation feed prior to contact with the acetylene hydrogenation catalyst based on the determination of the hydrogen concentration in the hydrogenation feed, wherein the temperature of the hydrogenation feed is decreased by from 0.5 °C to 2.0 °C for each incremental increase of 5 vol.% in the hydrogen concentration in the hydrogenation feed and increased by from 0.5 °C to 2.0 °C for each incremental decrease of 5 vol.% in the hydrogen concentration in the hydrogenation feed.

4. The method of any of any of claims 1-3, further comprising increasing or decreasing a concentration of CO in the hydrogenation feed based on the determination of the hydrogen concentration in the hydrogenation feed, wherein the concentration of CO in the hydrogenation feed is increased by at least 10 ppmv for each incremental increase of 5 vol.% in the hydrogen concentration in the hydrogenation feed and decreased by at least 10 ppmv for each incremental decrease of 5 vol.% in the hydrogen concentration in the hydrogenation feed.

5. The method of claim 4, wherein increasing or decreasing a concentration of CO in the hydrogenation feed comprises increasing or decreasing an amount of sulfur-containing compounds, oxygenates, or both introduced to the steam cracking unit.

6. A method for operating an acetylene hydrogenation unit in an olefin production system, the process comprising:

cracking at least a portion of a feedstock in a steam cracking unit to produce a cracked gas, the feedstock comprising one or more hydrocarbons;

passing at least a portion of the cracked gas to a separation system operable to produce at least a hydrogenation feed from the cracked gas, the hydrogenation feed comprising acetylene, carbon monoxide, hydrogen, and at least one product;

contacting the hydrogenation feed with an acetylene hydrogenation catalyst in an acetylene hydrogenation unit, the contacting causing hydrogenation of at least a portion of the acetylene in the hydrogenation feed to produce a hydrogenation effluent;

changing a composition of the feedstock cracked in the steam cracking unit, wherein changing the composition of the feedstock increases or decreases a hydrogen concentration in the hydrogenation feed;

in response to changing the composition of the feedstock, determining the hydrogen concentration in the acetylene hydrogenation unit; and

increasing or decreasing a temperature of the acetylene hydrogenation unit based on the determination of the hydrogen concentration in the acetylene hydrogenation unit.

7. The method of claim 6, wherein determining the hydrogen concentration in the acetylene hydrogenation unit comprises measuring a concentration of hydrogen in the cracked gas, the hydrogenation feed, the hydrogenation effluent, or combinations thereof.

8. The method of either of claims 6 or 7, wherein increasing or decreasing the temperature of the acetylene hydrogenation unit comprises increasing or decreasing a temperature of the hydrogenation feed passed to the acetylene hydrogenation unit based on the determination of the hydrogen concentration in the acetylene hydrogenation unit, wherein the temperature of the hydrogenation feed is decreased by from 0.5 °C to 2.0 °C for each incremental increase of 5 vol.% in the hydrogen concentration in the acetylene hydrogenation unit and increased by from 0.5 °C to 2.0 °C for each incremental decrease of 5 vol.% in the hydrogen concentration in the acetylene hydrogenation unit.

9. The method of any of claims 6-8, further comprising increasing or decreasing the concentration of CO in the acetylene hydrogenation unit based on the determination of the hydrogen concentration in the acetylene hydrogenation unit, wherein the concentration of CO in the acetylene hydrogenation unit is increased by at least 10 ppmv for each incremental increase of 5 vol.% in the hydrogen concentration in the acetylene hydrogenation unit and decreased by at least 10 ppmv for each incremental decrease of 5 vol.% in the hydrogen concentration in the acetylene hydrogenation unit.

10. The method of claim 9, wherein increasing or decreasing the concentration of CO in the acetylene hydrogenation unit comprises increasing or decreasing a concentration of CO in the hydrogenation feed.

11. The method of claim 10, wherein increasing or decreasing the concentration of CO in the hydrogenation feed comprises increasing or decreasing an amount of sulfur-containing constituents, oxygenates, or both introduced to the steam cracking unit.

12. The method of any of claims 7-11, wherein the acetylene hydrogenation unit comprises at least a first hydrogenation reactor and a second hydrogenation reactor downstream of the first hydrogenation reactor, and wherein a conversion of acetylene in the first hydrogenation reactor is less than or equal to 95%.

13. The method of claim 12, wherein the acetylene hydrogenation unit comprises at third hydrogenation reactor downstream of the second hydrogenation reactor.

14. The method of any of claims 1-13, wherein the hydrogenation feed comprises methyl acetylene and propadiene, and the at least one product comprises one or more of ethylene, propylene, methane, ethane, propane, or combinations of these.

15. The method of any of claims 1-14, wherein the hydrogenation effluent has a concentration of acetylene of less than or equal to 2 ppmv.