

Claims

1. A method for operating an acetylene hydrogenation unit of an integrated system for producing olefins, the method comprising:
 - separating a first process effluent from a first olefin production process into at least a hydrogenation feed and an acetylene-depleted stream in a separation system, the hydrogenation feed comprising at least acetylene, carbon monoxide, and hydrogen;
 - one or both of:
 - introducing at least a portion of a second process effluent from a second olefin production process to the separation system; or
 - combining the at least a portion of the second process effluent with the first process effluent upstream of the separation system;
 - wherein introducing the portion of the second process effluent to the separation system, combining the portion of the second process effluent with the first process effluent, or both, increases a concentration of carbon monoxide in the hydrogenation feed;
 - contacting the hydrogenation feed with an acetylene hydrogenation catalyst in the acetylene hydrogenation unit, the contacting causing hydrogenation of at least a portion of the acetylene in the hydrogenation feed to produce a hydrogenated effluent, wherein:
 - an elevated concentration of carbon monoxide in the hydrogenation feed reduces a reaction rate independent of temperature, of the hydrogenation of the acetylene;
 - the elevated concentration of carbon monoxide in the hydrogenation feed is due to the portion of the second process effluent; and
 - the acetylene hydrogenation unit operates at an elevated temperature relative to normal operating temperatures when the portion of the second effluent is not introduced to the separation system, combined with the first process effluent, or both, such that a concentration of acetylene in the hydrogenated effluent is less than a threshold acetylene concentration.
2. The method of claim 1, wherein the concentration of acetylene in the hydrogenated effluent does not increase above the threshold acetylene concentration during introducing the

portion of the second process effluent to the separation system, combining the portion of the second process effluent with the first process effluent, or both.

3. The method of either of claims 1 or 2, wherein the threshold acetylene concentration is less than or equal to 2.0 ppmv, or less than or equal to 1.0 ppmv.
4. The method of any of claims 1 through 3, wherein:
the acetylene hydrogenation unit comprises at least a first hydrogenation reactor and a second hydrogenation reactor downstream of the first hydrogenation reactor; and
the elevated temperature of the acetylene hydrogenation unit is sufficient to increase an acetylene conversion in the first hydrogenation reactor, immediately prior to integrating the portion of the second process effluent, to greater than a threshold acetylene conversion, the threshold acetylene conversion being a minimum acetylene conversion in the first hydrogenation reactor, before integration of the portion of the second process effluent, above which the acetylene concentration in the hydrogenated effluent is maintained less than or equal to the threshold acetylene concentration after integrating the portion of the second process effluent.
5. The method of claim 4, wherein the separation system is a front end depropanizer and the threshold acetylene conversion in the first hydrogenation reactor is greater than or equal to 0.95 for a flow ratio of less than or equal to 1/12, wherein the flow ratio is a mass flow rate of a portion of the hydrogenation feed contributed by the second process effluent divided by a mass flow rate of another portion of the hydrogenation feed contributed by the first process effluent.
6. The method of claim 4, wherein:
the separation system is a front end depropanizer;
a flow ratio is from 1/12 to 1/2, the flow ratio being a mass flow rate of a portion of the hydrogenation feed contributed by the second process effluent divided by a mass flow rate of another portion of the hydrogenation feed contributed by the first process effluent; and
the threshold acetylene conversion in the first hydrogenation reactor is greater than or equal a value calculated from $\min[(-0.00024 \cdot C_{CO} + 0.5 \cdot R + 0.942), 0.99]$, where C_{CO} is a carbon monoxide concentration in the hydrogenation feed contributed by

the cracked gas in parts per million by volume of the hydrogenation feed and R is the flow ratio.

7. The method of claim 4, wherein the separation system is a front end de-ethanizer and the threshold acetylene conversion in the first hydrogenation reactor is greater than or equal to 0.99 for a flow ratio less than or equal to 1/2, wherein the flow ratio is a mass flow rate of a portion of the hydrogenation feed contributed by the second process effluent divided by a mass flow rate of another portion of the hydrogenation feed contributed by the first process effluent.

8. The method of any of claims 1-7, further comprising:
introducing a first portion of the second process effluent to the separation system,
combining the first portion of the second process effluent with the first process effluent upstream of the separation system, or both, wherein introducing the first portion of the second process effluent to the separation system, combining the first portion of the second process effluent with the first process effluent, or both, increases the concentration of carbon monoxide in the hydrogenation feed and reduces the conversion of acetylene in the acetylene hydrogenation unit;
recycling a remaining portion of the second process effluent back to the second olefin production process;
increasing a temperature of the acetylene hydrogenation unit to increase the conversion of acetylene in the acetylene hydrogenation unit; and
passing at least a second portion of the second process effluent to the separation system, combining at least a second portion of the second process effluent with the first process effluent and the first portion of the second process effluent upstream of the separation system, or both, wherein integrating the at least a second portion of the second process effluent further increases the concentration of carbon monoxide in the hydrogenation feed and reduces the conversion of acetylene in the acetylene hydrogenation unit.

9. The method of claim 8, wherein a mass flow rate of a portion of the hydrocarbon feed contributed by the first portion of the second process effluent is greater than 0% and less than or equal to 12% of the mass flow rate of another portion of the hydrogenation feed contributed by the first process effluent.

10. The method of any of claims 1-9, further comprising increasing a carbon monoxide concentration of the first process effluent prior to introducing the at least a portion of the second process effluent.
11. The method of claim 10, further comprising, after introducing the portion of the second process effluent, decreasing a concentration of carbon monoxide in the first process effluent.
12. The method of any of claims 4-11, wherein the acetylene hydrogenation unit comprises at least a third hydrogenation reactor downstream of the second hydrogenation reactor.
13. The method of any of claims 1-12, wherein the hydrogenation feed comprises at least one product, the at least one product comprising one or more of ethylene, propylene, methane, ethane, propane, or combinations of these.
14. The method of any of claims 1-13, wherein the first process effluent is a cracked gas from a steam cracking system, and the second process effluent is an fluidized catalytic cracking effluent from a fluidized catalytic cracking (FCDh) system.
15. A method for operating an acetylene hydrogenation unit of a steam cracking system that integrates a fluidized catalytic dehydrogenation (FCDh) effluent from a fluidized catalytic dehydrogenation (FCDh) system, the method comprising:
 - cracking at least a portion of a first hydrocarbon feed in a steam cracking unit to produce a cracked gas;
 - separating the cracked gas into at least a hydrogenation feed and acetylene-depleted stream in a separation system, the hydrogenation feed comprising at least acetylene, carbon monoxide, hydrogen, and at least one product;
 - contacting the hydrogenation feed with an acetylene hydrogenation catalyst in the acetylene hydrogenation unit comprising at least a first hydrogenation reactor and a second hydrogenation reactor, the contacting causing hydrogenation of at least a portion of the acetylene in the hydrogenation feed to produce a hydrogenated effluent;
 - increasing a temperature of the hydrogenation feed such that a conversion of acetylene in the first hydrogenation reactor is greater than or equal to a threshold acetylene conversion, the threshold acetylene conversion being a minimum acetylene conversion in the first hydrogenation reactor, before integration of the portion of

the FCDh effluent, above which the acetylene concentration in the hydrogenated effluent is maintained less than or equal to the threshold acetylene concentration after integrating the portion of the FCDh effluent; and

dehydrogenating at least a portion of a second hydrocarbon feed in the FCDh system to produce the FCDh effluent, the FCDh effluent having a concentration of carbon monoxide greater than a concentration of carbon monoxide in the cracked gas;

introducing at least a portion of the FCDh effluent to the separation system, combining at least a portion of the FCDh effluent with the cracked gas upstream of the separation system, or both, wherein introducing the portion of the FCDh effluent to the separation system, combining the portion of the FCDh effluent with the cracked gas, or both, increases a concentration of carbon monoxide in the hydrogenation feed, wherein

an elevated concentration of carbon monoxide in the hydrogenation feed due to the portion of the FCDh effluent reduces a reaction rate, independent of temperature, of the hydrogenation of the acetylene; and

the elevated temperature of the acetylene hydrogenation unit relative to normal operating temperatures when the portion of the FCDh effluent is not introduced to the separation system, combined with the cracked gas, or both, maintains the concentration of acetylene in the hydrogenated effluent less than or equal to a threshold acetylene concentration.