

CLAIMS

1. A method for operating an acetylene hydrogenation unit in an integrated steam cracking-fluidized catalytic dehydrogenation (FCDh) system, the method comprising:
 - cracking at least a portion of a first hydrocarbon feed in a steam cracking system to produce a cracked gas comprising at least hydrogen, carbon monoxide (CO), and acetylene;
 - dehydrogenating at least a portion of a second hydrocarbon feed in an FCDh system to produce an FCDh effluent comprising at least hydrogen and CO;
 - separating the cracked gas and at least a portion of the FCDh effluent into a hydrogenation feed and an acetylene-depleted stream, the hydrogenation feed comprising at least hydrogen, CO, and acetylene, wherein the hydrogenation feed comprises at least 95% of the CO from the cracked gas and the FCDh effluent, and wherein during normal operating conditions at least 20% of the CO in the hydrogenation feed is from the cracked gas; and
 - 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 hydrogenated effluent;wherein the steam cracking system is operated under conditions that increase CO production such that a concentration of CO in the cracked gas is great enough that when a flowrate of the FCDh effluent is zero, a CO concentration in the hydrogenation feed is at least 100 ppmv.
2. The method of claim 1, wherein operating the steam cracking system under conditions that increase CO production such that the concentration of CO in the cracked gas is great enough that when the flowrate of the FCDh effluent is zero, the CO concentration in the hydrogenation feed is at least 100 ppmv reduces or prevents thermal runaway of the acetylene hydrogenation unit in response to a disruption in the flow of the FCDh effluent to the acetylene hydrogenation unit.
3. The method of either of claims 1 or 2, wherein the concentration of CO in the cracked gas is great enough that when the flowrate of the FCDh effluent is zero, the CO concentration in the hydrogenation feed is from 100 ppmv to 450 ppmv.

4. The method of any of the preceding claims, wherein maintaining the amount of the CO from the cracked gas in the hydrogenation feed greater than or equal to 20% by mass of the total amount of CO in the hydrogenation feed reduces or prevents thermal runaway of the acetylene hydrogenation unit in response to a disruption in flow of the FCDh effluent to the acetylene hydrogenation unit.
5. The method of any of the preceding claims, wherein the steam cracking system is operated under conditions that increase CO production by modifying an amount of sulfur-containing compounds, methanol, or both, introduced to the steam cracking system.
6. The method of claim 6, wherein the sulfur-containing compounds comprise at least one of dimethyl disulfide (DMDS), dimethyl sulfide (DMS), diethyl disulfide (DEDS), methyl mercaptan (MM), or combinations thereof.
7. The method of any one of the preceding claims, further comprising increasing a temperature of the hydrogenation feed in response to increasing an amount of CO in the cracked gas to maintain a concentration of acetylene in the hydrogenated effluent less than a target acetylene concentration.
8. The method of any one of the preceding claims, 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 maintaining the amount of CO from the cracked gas in the hydrogenation feed greater than or equal to 20% of the total amount of CO in the hydrogenation feed maintains a loss in overall ethylene selectivity of less than or equal to 80% in response to a decrease in the flow of the FCDh effluent to the acetylene hydrogenation unit.
9. The method of any one of the preceding claims, in which in response to a decrease in flow of the at least a portion of the FCDh effluent to the separator, an absolute value of a change in a Delta T of a first hydrogenation reactor of the acetylene hydrogenation unit is less than 10 °C, wherein the Delta T of the first hydrogenation reactor is a difference between an inlet temperature and an outlet temperature of the first hydrogenation reactor.
10. The method of any one of the preceding claims, wherein a flow ratio is less than or equal to 1/2, wherein the flow ratio is the mass flow rate of the portion of the FCDh effluent passed to

the separation system divided by the mass flow rate of the portion of the cracked gas in the hydrogenation feed.

11. The method of any one of the preceding claims, wherein the hydrogenation feed comprises methyl acetylene, propadiene, and at least one cracker product, the at least one cracker product comprising one or more of ethylene, propylene, methane, ethane, propane, or combinations of these.
12. The method of any one of the preceding claims, wherein the hydrogenated effluent has a concentration of acetylene of less than or equal to 2 ppm by volume.
13. The method of any one of the preceding claims, wherein the FCDh effluent comprises at least one FCDh product, wherein the at least one FCDh product comprises ethylene, propylene, or both.