SUMMARY OF THE CLAIMED EMBODIMENTS

[0004] It has been found that, for a catalytic distillation reactor system, concurrently selectively hydrogenating the acetylenic and diene impurities and separating the linear pentenes from cyclopentene, withdrawing a side draw fraction from the column at a location where cyclopentene is at a high concentration may greatly improve separation efficiency and/or reduce operating costs

[0005] In one aspect, embodiments disclosed herein relate to a process for the selective hydrogenation of acetylenes and dienes in a C5 hydrocarbon stream. The process ~~may~~ includes feeding hydrogen and a C5-olefin containing stream comprising linear pentenes, dienes, acetylenes, and cyclopentene to a catalytic distillation reactor system. Concurrently in the catalytic distillation reactor system, the acetylenes and dienes ~~may be~~ are hydrogenated and the C5-olefin containing stream ~~may be~~ is fractionated, thereby recovering an overheads fraction comprising the linear pentenes, a side draw fraction comprising the cyclopentene, and a bottoms fraction.

[0006] In another aspect, embodiments disclosed herein relate to a process for the conversion of linear pentenes to propylene. The process ~~may~~ includes feeding hydrogen and a C5-olefin containing stream comprising linear pentenes, dienes, acetylenes, and cyclopentene to a catalytic distillation reactor system. Concurrently in the catalytic distillation reactor system, the acetylenes and dienes ~~may be~~ are hydrogenated and the the C5-olefin containing stream ~~may be~~ is fractionated, thereby recovering an overheads fraction comprising the linear pentenes, a side draw fraction comprising the cyclopentene, and a bottoms fraction. At least a portion of the overheads fraction ~~may~~ is then ~~be~~ fed to a metathesis reactor for converting the linear pentenes to propylene.

[0007] In another aspect, embodiments disclosed herein relate to a system for the selective hydrogenation of acetylenes and dienes in a C5 hydrocarbon stream using the process defined above. The system ~~may~~ includes: one or more flow lines for feeding hydrogen and a C5-olefin containing stream comprising linear pentenes, dienes, acetylenes, and cyclopentene to a catalytic distillation reactor system; the catalytic distillation reactor system, for concurrently: hydrogenating the acetylenes and dienes; and fractionating the C5-olefin containing stream; an overheads system fluidly connected to the catalytic distillation reactor system for recovering an overheads fraction comprising the linear

pentenes; a flow line for recovering a side draw fraction comprising the cyclopentene from the catalytic distillation reactor system; and a bottoms system for recovering a bottoms fraction from the catalytic distillation reactor system.

[0008] Other ~~aspects~~ embodiments and advantages will be apparent from the following description and the appended claims.

BRIEF DESCRIPTION OF DRAWINGS

[0009] Figure 1 is a simplified process flow diagram of a process for selectively hydrogenating acetylenes and dienes in a crude C5 stream according to embodiments disclosed herein.

[0010] Figure 2 is a simplified process flow diagram of a process for selectively hydrogenating acetylenes and dienes in a crude C5 stream according to embodiments disclosed herein.

[0011] Figure 3 presents simulation results for a comparative column, without a side draw.

[0012] Figures 4-6 present simulation results for a catalytic distillation reactor system including a side draw for selectively hydrogenating acetylenes and dienes in crude C5 stream according to embodiments disclosed herein.

DETAILED DESCRIPTION

[0013] In one aspect, embodiments herein relate to an energy efficient process to produce linear C5 olefins with a very low level of cyclopentene. The linear C5 olefins may be suitable for use in a downstream metathesis unit for the production of propylene, for example.

[0014] Within the scope of this application, the expression "catalytic distillation reactor system" denotes an apparatus in which the catalytic reaction and the separation of the products take place at least partially simultaneously. The apparatus may comprise a conventional catalytic distillation column reactor, where the reaction and distillation are concurrently taking place at boiling point conditions, or a distillation column combined with at least one side reactor, where the side reactor may be operated as a liquid phase reactor or a boiling point reactor. While both catalytic distillation reactor systems described may be preferred over conventional liquid phase reaction followed by separations, a catalytic distillation column reactor may have the advantages of decreased piece count, reduced capital cost, increased

feeding hydrogen and a C5-olefin containing stream comprising linear pentenes, dienes, acetylenes, and cyclopentene to a catalytic distillation reactor system;

concurrently in the catalytic distillation reactor system:

hydrogenating the acetylenes and dienes; and

fractionating the C5-olefin containing stream;

recovering an overheads fraction comprising the linear pentenes;

recovering a side draw fraction comprising the cyclopentene;

recovering a bottoms fraction; and

feeding at least a portion of the overheads fraction to a metathesis reactor.

10. The process of claim 9, wherein the side draw is located intermediate a feed location of the C5-olefin containing stream and a bottoms draw location.
11. The process of claim 10, wherein the side draw is located below the feed stage and proximate an elevation of maximum cylcopentene concentration determined as if the side draw were not present.
12. The process of claim 9, wherein a mole ratio of the side draw rate to the feed rate is in the range from 0.001 to 0.01.
13. The process of claim 9, wherein a mole ratio of the side draw rate to the feed rate is in the range from 0.002 to 0.005.
14. The process of claim 9, wherein the catalytic distillation reactor system comprises a hydrogenation reaction zone located above a feed location of the C5-olefin containing stream.
15. The process of claim 14, wherein the catalytic distillation reactor system further comprises a hydrogenation reaction zone located below a feed location of the C5-olefin containing stream and above or proximate an elevation of the side draw.
16. The process of claim 9, wherein the side draw is substantially free of acetylenes and dienes.
17. A system for the selective hydrogenation of acetylenes and dienes in a C5 hydrocarbon stream using the process of claim 1, the system comprising:

one or more flow lines for feeding hydrogen and a C5-olefin containing stream comprising linear pentenes, dienes, acetylenes, and cyclopentene to a catalytic distillation reactor system;