CLAIMS

1. A process for recovering hydrogen from dehydrogenation reactor effluent, the process comprising:

passing a feed stream comprising hydrocarbons and hydrogen to a dehydrogenation reactor maintained at dehydrogenation conditions to provide a dehydrogenation reactor effluent, wherein hydrogen to hydrocarbon ratio of the feed stream is in the range of 0.01 to 0.4;

passing the dehydrogenation reactor effluent to a reactor effluent compressor to provide a compressed hydrocarbon stream;

passing the compressed hydrocarbon stream to a cold box separation unit to provide a liquid hydrocarbon product stream and a recycle hydrogen stream; ~~and~~

splitting the recycle hydrogen stream upstream of a cold combined feed exchanger located in the cold box separation unit; and

passing a return portion of the recycle hydrogen stream to the reactor effluent compressor.

2. The process of claim 1, further comprising mixing return portion of the recycle hydrogen stream with the dehydrogenation reactor effluent to provide an enriched stream and passing the enriched stream to the reactor effluent compressor.

3. The process of claim 2, wherein hydrogen to hydrocarbon ratio of the enriched stream is higher than hydrogen to hydrocarbon ratio of the dehydrogenation reactor effluent.

4. The process of claim 1, further comprising splitting the recycle hydrogen stream into the return portion and a charge portion of the recycle hydrogen stream.

5. The process of claim 4, wherein the return portion is 20-99 wt% of the recycle hydrogen stream and the charge portion is 1-80 wt% of the recycle hydrogen stream.

~~6. The process of claim 1, further comprising splitting the recycle hydrogen stream upstream of a cold combined feed exchanger located in the separation unit.~~

~~7~~6. The process of claim 4, further comprising mixing the charge portion of the recycle hydrogen stream with a hydrocarbons stream upstream of the cold combined feed exchanger to provide the feed stream for the dehydrogenation reactor.

~~8~~7. The process of claim ~~7~~6, further comprising exchanging heat between the feed stream and the compressed hydrocarbon stream in the cold combined feed exchanger.

~~9. The process of claim 1, wherein hydrogen to hydrocarbon ratio of the feed stream is in the range of 0.01 to 0.4.~~

~~10~~8. An apparatus for recovering hydrogen from dehydrogenation reactor effluent comprising:

a dehydrogenation reactor operating under dehydrogenation conditions configured to selectively dehydrogenate a feed stream comprising hydrocarbons and hydrogen and provide a dehydrogenation reactor effluent, wherein hydrogen to hydrocarbon ratio of the feed stream is in the range of 0.01 to 0.4;

a reactor effluent compressor in fluid communication with the dehydrogenation reactor via the dehydrogenation reactor effluent and configured to compress the dehydrogenation reactor effluent to provide a compressed hydrocarbon stream;

a cold box separation unit comprising of a cold combined feed exchanger in fluid communication with the reactor effluent compressor via the compressed hydrocarbon stream and configured to provide a liquid hydrocarbon product stream and a recycle hydrogen stream; ~~and~~

a split is present upstream of the cold combined feed exchanger to divide the recycle hydrogen stream; and

the reactor effluent compressor is in fluid communication with the cold box separation unit via a return portion of the recycle hydrogen stream.