CLAIMS

What is claimed:

1. A process for the recovery of ethane, comprising:

   feeding a first stream comprising methane, ethane, and ethylene to a reboiled absorber column;

   contacting the first stream with an absorbent-reactant in the reboiled absorber column to absorb essentially all of the ethane and ethylene, producing a rich oil bottoms stream comprising the absorbent-reactant, ethylene, and ethane, and a vapor stream comprising methane;

   reacting the ethylene and the absorbent-reactant in a reaction zone, producing a reaction zone effluent comprising ethane and a reaction product;

   stripping the effluent in a stripper to produce a lean oil bottoms stream and an overhead vapor stream comprising ethane, wherein:

   the reboiled absorber column is operated with an overhead pressure of from 1378.95 kPag to 3347.38 kPag (from 200 psig to 500 psig) and a bottoms temperature of from 150°C to 220°C; and

   the stripper is operated with an overhead pressure in the range of from 517.11 kPag to 3447.38 kPag (from 75 psig to 500 psig) and a bottoms temperature of from 200°C to 280°C.

2. The process of claim 1, wherein the first stream and the vapor stream each further comprise one or more of nitrogen, hydrogen, carbon monoxide, and carbon dioxide.
3. The process of claim 1, further comprising recycling at least a portion of the lean oil bottoms steam from the stripper to the reboiled absorber column as the absorbent-reactant.
4. The process of claim 3, further comprising introducing the absorbent-reactant proximate an upper end of the reboiled absorber column at a temperature in the range from about -20°C to about 50°C.
5. The process of claim 1, wherein the reboiled absorber column comprises multiple reboilers configured to sequentially extract heat from the lean oil bottoms stream from the stripper.
6. The process of claim 5, wherein the multiple reboilers comprise one or more side reboilers.

7. The process of claim 5, further comprising extracting heat from the lean oil bottoms stream from the stripper via one or more stripper side reboilers.
8. The process of claim 5, further comprising contacting the lean oil bottoms stream in indirect heat exchange with the reaction zone effluent and/or the rich oil bottoms stream.
9. The process of claim 8, further comprising withdrawing a portion of the lean oil stream intermediate the contacting in indirect heat exchange and introduction of a remaining portion of the lean oil stream to the reboiled absorber column.
10. The process of claim 9, further comprising admixing fresh and/or make-up adsorbent-reactant with the remaining portion of the lean oil stream.
11. The process of claim 1, further comprising feeding the overhead vapor stream comprising ethane to a cracker.
12. A process for the recovery of ethane, comprising:

feeding a first stream comprising methane, ethane, and ethylene to a reboiled absorber column;

contacting the first stream with an absorbent-reactant in the reboiled absorber column, producing a rich oil stream comprising the absorbent-reactant, ethylene, and ethane, and a vapor stream comprising methane;

reacting the ethylene and the absorbent-reactant in a reaction zone, producing an effluent comprising ethane and a reaction product;

stripping the effluent in a stripper to produce a lean oil bottoms stream and an overhead vapor stream comprising ethane;

contacting the overhead vapor stream with a first portion of a second absorbent-reactant in a first scrubber to absorb unreacted ethylene or absorbent-reactant in the overhead vapor stream and to produce a first scrubber bottoms stream comprising the second absorbent-reactant and a first scrubber overhead stream comprising ethane;

contacting the vapor stream comprising methane with a second portion of the second absorbent-reactant in a second scrubber to absorb ethane, ethylene, and/or absorbent-reactant present in the vapor stream and to produce a second scrubber bottoms stream comprising the second absorbent-reactant and a second scrubber overhead stream comprising methane, wherein:

the reboiled absorber column is operated with an overhead pressure of from 1378.95 kPag to 3347.38 kPag (from 200 psig to 500 psig) and a bottoms temperature of from 150°C to 220°C; and

the stripper is operated with an overhead pressure in the range of from 517.11 kPag to 3447.38 kPag (from 75 psig to 500 psig).

13. The process of claim 12, wherein the absorbent-reactant comprises benzene, the second absorbent-reactant comprises poly-ethylated benzenes, and the reaction product comprises ethylbenzene.
14. The process of claim 12, wherein the first stream and the vapor stream each further comprise nitrogen and/or hydrogen.
15. The process of claim 12, wherein:

the stripper is operated at a pressure in the range from about 100 psig to about 450 psig.

16. The process of claim 12, further comprising recycling at least a portion of the lean oil bottoms steam from the stripper to the reboiled absorber column as the absorbent-reactant, wherein the absorbent-reactant in introduced to the reboiled absorber column at a temperature in the range from about -20°C to about 50°C.
17. A system for the recovery of ethylene from a dilute ethylene stream, comprising:

a reboiled absorber column for contacting a stream comprising methane, ethane, and ethylene with an absorbent-reactant, producing a rich oil stream comprising the absorbent-reactant, ethylene, and ethane, and a vapor stream comprising methane;

a reaction zone for reacting the ethylene and the absorbent-reactant, producing an effluent comprising ethane and a reaction product;

a stripper for stripping the effluent to produce a lean oil bottoms stream and an overhead vapor stream comprising ethane;

a first scrubber for contacting the overhead vapor stream with a first portion of a second absorbent-reactant to absorb unreacted ethylene or absorbent-reactant in the overhead vapor stream and to produce a first scrubber bottoms stream comprising the second absorbent-reactant and a first scrubber overhead stream comprising ethane;

a second scrubber for contacting the vapor stream comprising methane with a second portion of the second absorbent-reactant to absorb ethane, ethylene, and/or

absorbent-reactant present in the vapor stream and to produce a second scrubber bottoms stream comprising the second absorbent-reactant and a second scrubber overhead stream comprising methane, wherein the system further comprises:

one or more heat exchangers for reboiling the reboiled absorber column at a bottoms temperature in the range from about 150°C to about 220°C; and

one or more heat exchangers for operating the stripper at a bottoms temperature in the range from about 200°C to about 280°C.

18. The system of claim 17, further comprising one or more heat exchangers to cool the absorbent-reactant upstream of the reboiled absorber column to a temperature in the range from about -20°C to about 50°C.
19. The system of claim 17, wherein the reboiled absorber column comprises multiple reboilers configured to sequentially extract heat from the lean oil bottoms stream from the stripper.
20. The system of claim 19, wherein the multiple reboilers comprise one or more side reboilers.
21. The system of claim 17, further comprising one or more stripper side reboilers for extracting heat from the lean oil bottoms stream from the stripper.
22. The system of claim 17, further comprising one or more heat exchangers for contacting the lean oil bottoms stream in indirect heat exchange with the reaction zone effluent and/or the rich oil bottoms stream.