CLAIMS

We Claim:

1. A process for recovery of ethylene from a polymerization product stream of a polyethylene production system, comprising:

separating a light gas stream from the polymerization product stream, wherein the light gas stream comprises ethane and unreacted ethylene;

contacting the light gas stream with an absorption solvent system, wherein the contacting the light gas stream with the absorption solvent system occurs at a temperature in a range of from about 40° F to about 110° F, wherein at least a portion of the unreacted ethylene from the light gas stream is absorbed by the absorption solvent system; and

recovering unreacted ethylene from the absorption solvent system to yield recovered ethylene.

2. The process of Claim 1, wherein the absorption solvent system comprises copper chloride, aniline, and N-methylpyrrolidone.

3. The process of Claims 1 through 2, wherein the contacting the light gas stream with the absorption solvent system occurs at a temperature in a range of from about 40° F to about 60° F.

4. The process of Claims 1 through 3, wherein the contacting the light gas stream with the absorption solvent system occurs at a temperature of about 50° F.

5. The process of Claims 1 through 2, wherein the contacting the light gas stream with the absorption solvent system occurs at a temperature in a range of from about 60° F to about 90° F.

6. The process of Claims 1 through 5, further comprising:

introducing a stripping gas into the absorption solvent system, wherein at least a portion of the stripping gas is absorbed by the absorption solvent system.

7. The process of Claim 6, wherein the stripping gas is selected from the group consisting of nitrogen and isobutane.

8. The process of Claims 1 through 7, wherein the contacting the light gas stream with the absorption solvent system comprises bubbling the light gas stream through a packed bed in the absorption solvent system.

9. The process of Claims 1 through 8, wherein the contacting the light gas stream with the absorption solvent system comprises pressurizing the light gas stream and the absorption solvent system to a pressure in a range of from about 40 psig to about 60 psig.

10. The process of Claims 1 through 9, wherein the recovering unreacted ethylene from the absorption solvent system comprises depressurizing the absorption solvent system having absorbed unreacted ethylene at a temperature in a range of from about 110° F to about 200° F.

11. The process of Claims 1 through 10, wherein the depressurizing the absorption solvent system occurs at a pressure in a range of from about 0 psig to about 10 psig.

12. The process of Claims 1 through 11, wherein the depressurizing the absorption solvent system having absorbed unreacted ethylene occurs at a temperature in a range of from about 140° F to about 160° F.

13. The process of Claims 1 through 11, wherein the depressurizing the absorption solvent system having absorbed unreacted ethylene occurs at a temperature in a range of from about 160° F to about 200° F.

14. The process of Claims 1 through 13, further comprising:

removing at least a portion of elemental oxygen or oxygen-containing compounds from the light gas stream before contacting the light gas stream with the absorption solvent system.

15. A polyethylene production process, comprising:

contacting ethylene and a polymerization catalyst in a polymerization reactor under suitable reaction conditions to yield a polymerization product stream;

separating a light gas stream from the polymerization product stream, wherein the light gas stream comprises unreacted ethylene;

contacting the light gas stream with an absorption solvent system in an absorption reactor at a temperature in a range of from about 40° F to about 110° F, wherein at least a portion of the unreacted ethylene from the light gas stream is absorbed by the absorption solvent system to yield a composition comprising a complex of the absorption solvent system and unreacted ethylene;

removing unabsorbed gases of the light gas stream from contact with the absorption solvent system;

recovering unreacted ethylene from the absorption solvent system; and

contacting the recovered ethylene and the polymerization catalyst.

16. The process of Claim 15, further comprising:

introducing a stream comprising the composition comprising the complex of the absorption solvent system and unreacted ethylene into a solvent regenerator at a temperature in a range of about 50° F to about 200° F;

recovering unreacted ethylene from the composition comprising the complex of the absorption solvent system and unreacted ethylene to yield recovered ethylene and a regenerated absorption solvent system;

introducing a stream comprising the recovered ethylene into the polymerization reactor; and

introducing a stream comprising the regenerated absorption solvent system into the absorption reactor.

17. The process of Claims 15 through 16, wherein the introducing a stream comprising the composition comprising the complex of the absorption solvent system and unreacted ethylene into a solvent regenerator occurs at a pressure in a range of about 0 psig to about 10 psig.

18. The process of Claim 15, wherein the recovering unreacted ethylene from the absorption solvent system comprises depressurizing the absorption reactor to a pressure in a range of from about 0 psig to about 10 psig.

19. The process of Claims 1 through 18, further comprising:

removing unabsorbed gases of the light gas stream from contact with the absorption solvent system to form a waste gas stream.

20. The process of Claim 19, further comprising:

processing the waste gas stream in a processing device, wherein the processing device comprises a cracker, catalytic cracker, scrubber, converter, treater, dehydrogenator, deoxygenator, flare or combinations thereof.

21. The process of Claims 15 through 20, wherein the absorption solvent system comprises copper chloride, aniline, and N-methylpyrrolidone.

22. The process of Claims 15, 18 through 21, wherein the contacting the light gas stream with the absorption solvent system in an absorption reactor comprises pressurizing the absorption reactor to a pressure in a range of from about 40 psig to about 60 psig.

23. The process of Claims 15 through 22, further comprising:

removing at least a portion of elemental oxygen or oxygen-containing compounds from the light gas stream before introducing the light gas stream into the absorption reactor.

24. A polyethylene production system, comprising:

a feed stream comprising ethylene, wherein the feed stream is characterized by introduction into a polymerization reactor;

a polymerization product stream, wherein the polymerization product stream is characterized by emission from the polymerization reactor and introduction into a separator;

a light gas stream comprising unreacted ethylene, wherein the light gas stream is characterized by emission from the separator, the light gas stream having been separated from the polymerization product stream, wherein the light gas stream is characterized by introduction into an absorption solvent system, wherein the absorption solvent system has a temperature in a range of from about 40° F to about 110° F;

an absorbent-ethylene conjugant, wherein the absorbent-ethylene conjugant is characterized by formation within the absorption solvent system by absorption of at least a portion of the unreacted ethylene by the absorption solvent system; and

a waste gas stream comprising ethane, wherein the waste gas stream is characterized by emission from the absorption reactor, wherein the waste gas stream comprises components of the light gas stream that are not absorbed by the absorption solvent system; and

a recovered unreacted ethylene stream, wherein the recovered unreacted ethylene stream is characterized by emission from the absorption reactor and reintroduction into the polymerization reactor.

25. The system of Claim 24, wherein recovery of the recovered unreacted ethylene from the absorbent-ethylene conjugant occurs via a pressure reduction from a pressure of the absorption reactor to a pressure in a range of from about 0 psig to about 10 psig.

26. The system of Claims 24 through 25, wherein recovery of the recovered unreacted ethylene from the absorbent-ethylene conjugant occurs at a temperature in a range of about 110° F to about 200° F.

27. The system of Claims 24 through 26, wherein the absorption solvent system comprises copper chloride, aniline, and N-methylpyrrolidone.

28. A polyethylene production system, comprising:

a polymerization reactor, wherein the polymerization reactor is configured to receive a feed stream comprising ethylene, and wherein the polymerization reactor is configured to emit a polymerization product stream;

a separator, wherein the separator is configured to receive the polymerization product stream and to emit a light gas stream comprising unreacted ethylene, wherein the light gas stream has been separated from the polymerization product stream; and

an absorption reactor comprising an absorption solvent system, wherein the absorption reactor is configured to receive the light gas stream, to absorb at least a portion of the unreacted ethylene with the absorption solvent system at a temperature in a range of from about 40° F to about 110° F, and to emit a waste gas stream comprising components of the light gas stream that are not absorbed by the absorption solvent system, and wherein the absorption reactor is further configured to emit a recovered unreacted ethylene stream, and wherein the polymerization reactor is further configured to receive the recovered unreacted ethylene stream.

29. The system of Claim 28, wherein the recovered unreacted ethylene is recovered from the absorption solvent system via a pressure reduction from a pressure of the absorption reactor to a pressure in a range of from about 0 psig to about 10 psig.

30. The system of Claims 28 through 29, wherein the recovered unreacted ethylene is recovered from the absorption solvent system via a temperature increase from the absorption temperature to a temperature in a range of from about 110° F to about 200° F.

31. The system of Claims 28 through 30, wherein the absorption reactor comprises two or more packed-bed reactors, wherein the recovered unreacted ethylene is recovered from the absorption solvent system via a pressure reduction of one of the two or more packed-bed reactors while another of the packed bed reactors operates at a pressure in a range of from about 40 psig to about 60 psig.

32. The system of Claims 28 through 31, wherein the absorption solvent system comprises copper chloride, aniline, and N-methylpyrrolidone.

33. The system of Claims 28 through 32, further comprising a second absorption reactor, wherein the absorption reactors are configured to absorb ethylene in a liquid solvent through pressure swing absorption.

34. A polyethylene production system, comprising:

a polymerization reactor, wherein the polymerization reactor is configured to receive a feed stream comprising ethylene, and wherein the polymerization reactor is configured to emit a polymerization product stream;

a separator, wherein the separator is configured to receive the polymerization product stream and to emit a light gas stream comprising unreacted ethylene, wherein the light gas stream has been separated from the polymerization product stream;

an absorption reactor comprising an absorption solvent system, wherein the absorption reactor is configured to receive the light gas stream, to absorb at least a portion of the unreacted ethylene with the absorption solvent system at a temperature in a range of from about 40° F to about 110° F and to emit a waste gas stream comprising components of the light gas stream that are not absorbed by the absorption solvent system, wherein the absorption reactor is further configured to emit a complexed stream comprising ethylene absorbed in the absorbent solvent system; and

a solvent regenerator to regenerate the absorption solvent system, and to emit a recovered unreacted ethylene stream, wherein the polymerization reactor is further configured to receive the recovered unreacted ethylene stream.

35. The system of Claim 34, wherein the solvent regenerator is configured to operate at a pressure in a range of from about 0 psig to about 10 psig.

36. The system of Claims 34 through 35, wherein the solvent regenerator is configured to operate at a temperature in a range of from about 110° F to about 200° F.

37. The system of Claims 24 through 36, further comprising a processing device configured to receive the waste gas stream.

38. The system of Claim 37, wherein the processing device comprises a cracker, catalytic cracker, scrubber, converter, treater, dehydrogenator, deoxygenator, flare or combinations thereof.

CLAIMS

We claim:

1. A process for recovery of ethylene from a polymerization product stream of a polyethylene production system, comprising:

separating a light gas stream from the polymerization product stream, wherein the light gas stream comprises ethane and unreacted ethylene;

contacting the light gas stream with an absorption solvent system, wherein the contacting the light gas stream with the absorption solvent system occurs at a temperature in a range of from about 40° F. to about 110° F., wherein at least a portion of the unreacted ethylene from the light gas stream is absorbed by the absorption solvent system; and

recovering unreacted ethylene from the absorption solvent system to yield recovered ethylene,

wherein recovering unreacted ethylene from the absorption solvent system comprises depressurizing the absorption solvent system having absorbed unreacted ethylene at a temperature in a range of from about 160° F. to about 200° F.

2. The process of claim 1, wherein the absorption solvent system comprises copper chloride, aniline, and N-methylpyrrolidone.

3. The process of claim 1, wherein the contacting the light gas stream with the absorption solvent system occurs at a temperature in a range of from about 40° F. to about 60° F.

4. The process of claim 3, wherein the contacting the light gas stream with the absorption solvent system occurs at a temperature of about 50° F.

5. The process of claim 1, wherein the contacting the light gas stream with the absorption solvent system comprises bubbling the light gas stream through a packed bed in the absorption solvent system.

6. The process of claim 1, wherein the contacting the light gas stream with the absorption solvent system comprises pressurizing the light gas stream and the absorption solvent system to a pressure in a range of from about 40 psig to about 60 psig.

7. The process of claim 1, wherein the depressurizing the absorption solvent system occurs at a pressure in a range of from about 0 psig to about 10 psig.

8. A process for recovery of ethylene from a polymerization product stream of a polyethylene production system, comprising.

separating a light gas stream from the polymerization product stream, wherein the light gas stream comprises ethane and unreacted ethylene;

contacting the light gas stream with an absorption solvent system, wherein the contacting the light gas stream with the absorption solvent system occurs at a temperature in a range of from about 40° F. to about 110° F., wherein at least a portion of the unreacted ethylene from the light gas stream is absorbed by the absorption solvent system;

introducing a stripping gas into the absorption solvent system, wherein at least a portion of the stripping gas is absorbed by the absorption solvent system; and

recovering unreacted ethylene from the absorption solvent system to yield recovered ethylene.

9. The process of claim 8, wherein the contacting the light gas stream with the absorption solvent system occurs at a temperature in a range of from about 60° F. to about 90° P.

10. The process of claim 9, wherein the stripping gas is selected from the group consisting of nitrogen and isobutane.

11. A process for recovery of ethylene from a polymerization product stream of a polyethylene production system, comprising:

separating a light gas stream from the polymerization product stream, wherein the light gas stream comprises ethane and unreacted ethylene;

removing at least a portion of elemental oxygen or oxygen-containing compounds from the light gas stream before contacting the light gas stream with an absorption solvent system;

contacting the light gas stream with the absorption solvent system, wherein the contacting the light gas stream with the absorption solvent system occurs at a temperature in

a range of from about 40° F. to about 110° F., wherein at least a portion of the unreacted ethylene from the light gas stream is absorbed by the absorption solvent system; and

recovering unreacted ethylene from the absorption solvent system to yield recovered ethylene.

12. The process of claim 11, wherein recovering unreacted ethylene from the absorption solvent system comprises depressurizing the absorption solvent system having absorbed unreacted ethylene at a temperature in a range of from about 160° F. to about 200° F.

13. The process of claim 12, wherein the depressurizing the absorption solvent system occurs at a pressure in a range of from about 0 psig to about 10 psig.

14. The process of claim 11, wherein the absorption solvent system comprises copper chloride, aniline, and N-methylpyrrolidone.

15. The process of claim 11, wherein the contacting the light gas stream with the absorption solvent system occurs at a temperature in a range of from about 40° F. to about 60° F.

16. The process of claim 11, wherein the contacting the light gas stream with the absorption solvent system occurs at a temperature of 50° F.

17. The process of claim 11, wherein the contacting the light gas stream with the absorption solvent system comprises pressurizing the light gas stream and the absorption solvent system to a pressure in a range of from about 40 psig to about 60 psig.

18. A polyethylene production process, comprising:

contacting ethylene and a polymerization catalyst in a polymerization reactor under suitable reaction conditions to yield a polymerization product stream;

separating a light gas stream from the polymerization product stream, wherein the light gas stream comprises unreacted ethylene;

contacting the light gas stream with an absorption solvent system in an absorption reactor at a temperature in a range of from about 40° F. to about 110° F., wherein at least a portion of the unreacted ethylene from the light gas stream is absorbed by the absorption solvent system to yield a composition comprising a complex of the absorption solvent system and unreacted ethylene;

removing unabsorbed gases of the light gas stream from contact with the absorption solvent system;

recovering unreacted ethylene from the absorption solvent system;

contacting the recovered ethylene and the polymerization catalyst;

introducing a stream comprising the composition comprising the complex of the absorption solvent system and unreacted ethylene into a solvent regenerator;

recovering at a temperature in a range of from about 16° F. to about 200° F. unreacted ethylene from the composition comprising the complex of the absorption solvent system and unreacted ethylene to yield recovered ethylene and a regenerated absorption solvent system;

introducing a stream comprising the recovered ethylene into the polymerization reactor; and

introducing a stream comprising the regenerated absorption solvent system into the absorption reactor.

19. The process of claim 18, wherein the introducing a stream comprising the composition comprising the complex of the absorption solvent system and unreacted ethylene into a solvent regenerator occurs at a pressure in a range of about 0 psig to about 10 psig.

20. The process of claim 18, wherein the recovering unreacted ethylene from the absorption solvent system comprises depressurizing the absorption reactor to a pressure in a range of from about 0 psig to about 10 psig.

21. The process of claim 18, further comprising:

removing unabsorbed gases of the light gas stream from contact with the absorption solvent system to form a waste gas stream.

22. The process of claim 18, wherein the absorption solvent system comprises copper chloride, aniline, and N-methylpyrrolidone.

23. The process of claim 18, wherein the contacting the light gas stream with the absorption solvent system in an absorption reactor comprises pressurizing the absorption reactor to a pressure in a range of from about 40 psig to about 60 psig.

24. The process of claim 18, further comprising:

removing at least a portion of elemental oxygen or oxygen-containing compounds from the light gas stream before introducing the light gas stream into the absorption reactor.

25. A polyethylene production system, comprising:

a polymerization reactor, wherein the polymerization reactor is configured to receive a feed stream comprising ethylene, and wherein the polymerization reactor is configured to emit a polymerization product stream;

a separator, wherein the separator is configured to receive the polymerization product stream and to emit a light gas stream comprising unreacted ethylene, wherein the light gas stream has been separated from the polymerization product stream; and

an absorption reactor comprising an absorption solvent system, wherein the absorption reactor is configured to receive the light gas stream, to absorb at least a portion of the unreacted ethylene with the absorption solvent system at a temperature in a range of from about 40° F. to about 110° F., and to emit a waste gas stream comprising components of the light gas stream that are not absorbed by the absorption solvent system, and wherein the absorption reactor is further configured to emit a recovered unreacted ethylene stream, and wherein the polymerization reactor is further configured to receive the recovered unreacted ethylene stream,

wherein the absorption reactor comprises two or more packed-bed reactors, wherein the recovered unreacted ethylene is recovered from the absorption solvent system via a pressure reduction of one of the two or more packed-bed reactors while another of the two or more packed bed reactors operates at a pressure in a range of from about 40 psig to about 60 psig.

26. The system of claim 25, wherein the pressure reduction is from a pressure of the absorption reactor to a pressure in a range of from about 0 psig to about 10 psig.

27. The system of claim 25, wherein the recovered unreacted ethylene is recovered from the absorption solvent system via a temperature increase from the absorption temperature to a temperature in a range of from about 160° F. to about 200° F.

28. The system of claim 25, wherein the absorption solvent system comprises copper chloride, aniline, and N-methylpyrrolidone.

29. A polyethylene production system, comprising:

a polymerization reactor, wherein the polymerization reactor is configured to receive a feed stream comprising ethylene, and wherein the polymerization reactor is configured to emit a polymerization product stream;

a separator, wherein the separator is configured to receive the polymerization product stream and to emit a light gas stream comprising unreacted ethylene, wherein the light gas stream has been separated from the polymerization product stream;

a first absorption reactor comprising an absorption solvent system, wherein the first absorption reactor is configured to receive the light gas stream, to absorb at least a portion of the unreacted ethylene with the absorption solvent system at a temperature in a range of from about 40° F. to about 110° F., and to emit a waste gas stream comprising components of the light gas stream that are not absorbed by the absorption solvent system, and wherein the first absorption reactor is further configured to emit a recovered unreacted ethylene stream, and wherein the polymerization reactor is further configured to receive the recovered unreacted ethylene stream; and

a second absorption reactor, wherein the first and second absorption reactors are configured to absorb ethylene in a liquid solvent through pressure swing absorption.

30. The system of claim 29, wherein the recovered unreacted ethylene is recovered from the absorption solvent system via a pressure reduction.

31. The system of claim 30, wherein the pressure reduction is from a pressure of the absorption reactor to a pressure in a range of from about 0 psig to about 10 psig.

32. The system of claim 29, wherein the recovered unreacted ethylene is recovered from the absorption solvent system via a temperature increase from the absorption temperature to a temperature in a range of from about 160° F. to about 200° F.

33. The system of claim 29, wherein the absorption solvent system comprises copper chloride, aniline, and N-methylpyrrolidone.