

CLAIMS

What is claimed is:

1. A gas processing facility for processing a hydrocarbon gas stream comprising sulfurous components and carbon dioxide, the gas processing facility comprising:
 - 5 an acid gas removal facility for separating the hydrocarbon gas stream into (i) a sweetened gas stream, and (ii) a first acid gas stream comprised primarily of hydrogen sulfide and carbon dioxide;
a Claus sulfur recovery unit for receiving the acid gas stream, and separating the first acid gas stream into (i) a liquid stream of elemental sulfur, and (ii) a tail gas comprising acid
10 gas impurities;
a tail gas treating unit for receiving the tail gas, and separating the tail gas into (i) an overhead by-products stream from an absorber vessel, and (ii) a second acid gas stream from a regenerator vessel, the second acid gas stream containing a substantial portion of the hydrogen sulfide and the carbon dioxide in the tail gas; and
15 a compressor station for receiving the second acid gas stream from the regenerator vessel, and providing pressure to the second acid gas stream for injection into a subsurface reservoir.
2. The gas processing facility of claim 1, wherein the tail gas treating unit is also for
20 reducing the oxidized sulfur species to H₂S.
3. The gas processing facility of claim 1, wherein the absorber vessel utilizes an amine that absorbs both carbon dioxide and sulfurous components such that a majority of the carbon dioxide entering the tail gas treating unit is absorbed in the absorber vessel and released from
25 the absorber vessel to the regenerator vessel as a rich solvent stream.
4. The gas processing facility of claim 3, wherein the amine comprises diethanol amine (DEA), diisopropanol amine (DIPA), monoethanol (MEA), or combinations thereof.
- 30 5. The gas processing facility of claim 3, wherein:
the amine comprises methyl diethanol amine (MDEA); and
the MDEA is activated to facilitate CO₂ absorption.

6. The gas processing facility of claim 5, wherein the MDEA is activated with piperazine.
7. The gas processing facility of claim 1, further comprising:
5 a plurality of acid gas injection wells for transmitting the second acid gas stream from the compressor station to the subsurface reservoir.
8. The gas processing facility of claim 7, wherein the overhead gas stream is used for enhanced oil recovery operations in the subsurface reservoir.
- 10 9. The gas processing facility of claim 3, further comprising:
a heat exchanger for warming the rich solvent stream before it enters the regenerator vessel.
- 15 10. The gas processing facility of claim 3, wherein a portion of the first acid gas stream from the acid gas removal facility is taken to the compressor station and placed under pressure for injection into the subsurface reservoir along with the second acid gas stream from the regenerator vessel.
- 20 11. The gas processing facility of claim 3, further comprising:
a condenser vessel for separating residual amine and condensed water from carbon dioxide and sulfurous components in the second acid gas stream; and
a line for directing the residual amine and condensed water back to the regenerator vessel;
25 and wherein the second acid gas stream from the regenerator vessel is taken through the condenser vessel for removal of residual amine before it is delivered to the compressor station.
- 30 12. The gas processing facility of claim 3, further comprising:
an acid gas enrichment facility for receiving the first acid gas stream from the acid gas removal facility, and separating the acid gas stream into (i) an overhead CO₂-rich stream, and
(ii) an H₂S-rich acid gas stream; and
wherein:

the first acid gas stream received by the Claus sulfur recovery unit is the H₂S-rich acid gas stream, and

the overhead CO₂-rich stream is directed from the acid gas enrichment facility to the compressor station and placed under pressure for injection into the subsurface reservoir along with the second acid gas stream from the regenerator vessel of the tail gas treating unit.

13. The gas processing facility of claim 12, further comprising:

a single-stage, co-current contactor placed between the quench tower and the absorber vessel of the tail gas treating unit for (i) at least partially removing H₂S from the tail gas before it is delivered to the absorber vessel, and (ii) releasing a CO₂-rich stream to the absorber vessel in the tail gas treating unit.

14. The gas processing facility of claim 3, further comprising:

an incinerator for receiving the overhead by-products stream from the absorber vessel for incineration.

15. The gas processing facility of claim 14, wherein the incinerator either incinerates through a fuel gas combustion process, or through a catalytic incineration process.

16. The gas processing facility of claim 1, wherein the hydrocarbon gas stream comprises raw natural gas from a hydrocarbon production operation, a flue gas stream from an industrial power plant, or a CO₂ emission from a cement plant.

17. A method for processing a hydrocarbon gas stream in a gas processing facility, the hydrocarbon gas stream comprising sulfurous components and carbon dioxide, the method comprising:

separating the hydrocarbon gas stream at an acid gas removal facility into (i) a sweetened gas stream, and (ii) a first acid gas stream comprised primarily of hydrogen sulfide and carbon dioxide;

receiving the acid gas stream at a Claus sulfur recovery unit and separating the acid gas stream into (i) a liquid stream of elemental sulfur, and (ii) a tail gas comprising acid gas impurities;

receiving the tail gas at a tail gas treating unit, and separating the tail gas into (i) an overhead by-products stream from an absorber vessel, and (ii) a second acid gas stream from a regenerator vessel, the second acid gas stream containing a substantial portion of the carbon dioxide in the tail gas;

5 delivering the second acid gas stream from the regenerator vessel to a compressor station;

providing pressure to the second acid gas stream from the regenerator vessel at a compressor station; and

10 injecting the second acid gas stream into a subsurface reservoir.

18. The method of claim 17, wherein the absorber vessel utilizes an amine that absorbs both carbon dioxide and sulfurous components such that a majority of the carbon dioxide entering the tail gas treating unit is absorbed in the absorber vessel and released from the absorber vessel to the regenerator vessel along with sulfurous components as a rich solvent

15 stream.

19. The method of claim 18, wherein the amine comprises diethanol amine (DEA), diisopropanol amine (DIPA), monoethanol (MEA), or combinations thereof.

20 20. The method of claim 18, wherein:
the amine comprises methyl diethanol amine (MDEA); and
the MDEA is activated to facilitate CO₂ absorption.

21. The method of claim 20, wherein the MDEA is activated with piperazine.

25

22. The method of claim 17, further comprising:
providing a plurality of acid gas injection wells for transmitting the second acid gas stream from the regenerator vessel in the tail gas treating unit to the subsurface reservoir for enhanced oil recovery operations.

30

23. The method of claim 17, wherein a portion of the first acid gas stream from the acid gas removal facility is taken to the compressor station and placed under pressure for injection into the subsurface reservoir along with the second acid gas stream from the regenerator vessel of the tail gas treating unit.

24. The method of claim 18, further comprising:

separating residual amine and condensed water from carbon dioxide and sulfurous components in the second acid gas stream in a condenser vessel; and

5 directing the residual amine and condensed water back to the regenerator vessel;

wherein the second acid gas stream from the regenerator vessel is taken through the condenser vessel for removal of residual amine before it is delivered to the compressor station.

10 25. The method of claim 17, wherein:

the gas processing facility further comprises an acid gas enrichment facility for receiving the first acid gas stream from the acid gas removal facility, and separating the acid gas stream into (i) an overhead CO₂-rich stream, and (ii) an H₂S-rich acid gas stream; and

the method further comprises:

15 receiving the H₂S-rich acid gas stream as the acid gas stream at the Claus sulfur recovery unit;

delivering the overhead CO₂-rich stream to the compressor station;

providing pressure to the overhead CO₂-rich stream at the compressor station;

and

20 injecting the overhead CO₂-rich stream into the subsurface reservoir along with the second acid gas stream from the regenerator vessel of the tail gas treating unit.

26. The method of claim 17, further comprising:

25 incinerating the overhead by-products stream from the absorber vessel; and

venting the incinerated by-products stream into the atmosphere.

CLAIMS

What is claimed is:

1. A gas processing facility for processing a hydrocarbon gas stream comprising sulfurous components and carbon dioxide, the gas processing facility comprising:

an acid gas removal facility for separating the hydrocarbon gas stream into (i) a sweetened gas stream, and (ii) a first acid gas stream comprised primarily of hydrogen sulfide and carbon dioxide;

a Claus sulfur recovery unit for receiving the acid gas stream, and separating the first acid gas stream into (i) a liquid stream of elemental sulfur, and (ii) a tail gas comprising acid gas impurities;

a tail gas treating unit for receiving the tail gas, and separating the tail gas into (i) an overhead by-products stream from an absorber vessel, and (ii) a second acid gas stream from a regenerator vessel, the second acid gas stream containing a substantial portion of the hydrogen sulfide and the carbon dioxide in the tail gas; and

a compressor station for receiving the second acid gas stream from the regenerator vessel, and providing pressure to the second acid gas stream for injection into a subsurface reservoir.

wherein the absorber vessel utilizes an amine that absorbs both carbon dioxide and sulfurous components such that a majority of the carbon dioxide entering the tail gas treating unit is absorbed in the absorber vessel and released from the absorber vessel to the regenerator vessel as a rich solvent stream and wherein an incinerator (which either incinerates through a fuel gas combustion process, or through a catalytic incineration process) is provided for receiving the overhead by-products stream from the absorber vessel for incineration.