CLAIMS

1. An enrichment apparatus for enriching a hydrogen sulfide concentration in an acid gas stream to create a hydrogen sulfide rich stream for feed to a Claus unit, the enrichment apparatus comprising:

   a hydrocarbon selective separation unit, the hydrocarbon selective separation unit operable to separate the acid gas stream into a hydrocarbon rich stream and a purified acid gas stream, wherein the acid gas stream comprises aromatics selected from the group consisting of benzene, toluene, ethyl benzene, and xylenes; and

   a hydrogen sulfide selective separation unit in fluid communication with the hydrocarbon selective separation unit, the hydrogen sulfide selective separation unit operable to separate the purified acid gas stream to create the hydrogen sulfide rich stream and a hydrogen sulfide lean stream, the hydrogen sulfide rich stream having a concentration of hydrogen sulfide.

2. The enrichment apparatus of claim 1, further comprising:

   a carbon dioxide selective separation unit in fluid communication with the hydrogen sulfide selective separation unit, the carbon dioxide selective separation unit operable to separate the hydrogen sulfide rich stream to create a carbon dioxide rich permeate and a hydrogen sulfide rich retentate, the hydrogen sulfide rich retentate having a concentration of hydrogen sulfide.

3. The enrichment apparatus of claim 2, wherein the carbon dioxide selective separation unit is selected from the group consisting of an amorphous fluoroplastic membrane, an amorphous perfluoropolymer membrane, a random fluorocopolymer membrane, a perfluorinated copolymer membrane, and combinations thereof.

4. The enrichment apparatus of claim 1, further comprising

   a second hydrogen sulfide selective separation unit in fluid communication with the hydrogen sulfide selective separation unit, the second hydrogen sulfide selective separation unit operable to separate the hydrogen sulfide rich stream to create an enriched hydrogen sulfide stream and a carbon dioxide retentate.

5. The enrichment apparatus of claim 1, wherein the hydrogen sulfide selective separation unit is selected from the group consisting of polyphosphazene type polymer membranes, polyether-polyamide copolymer membranes, ionic liquid membranes, ionic liquid membrane contactors, and combinations thereof.

6. The enrichment apparatus of claim 5, wherein the second hydrogen sulfide selective separation unit is selected from the group consisting of polyphosphazene type polymer membranes, polyether-polyamide copolymer membranes, ionic liquid membranes, ionic liquid membrane contactors, and combinations thereof.

7. The enrichment apparatus of claim 1, wherein the hydrocarbon selective separation unit comprises a PDMS type rubbery polymer membrane.

8. The enrichment apparatus of claim 1, wherein the acid gas stream further comprises contaminants selected from the group consisting of mercaptans, thiols, carbonyl sulfide, carbon disulfide, and combinations thereof.

9. The enrichment apparatus of claim 1, wherein the hydrogen sulfide concentration in the acid gas stream is between 15% to 55% by volume.

10. The enrichment apparatus of claim 1, wherein the concentration of hydrogen sulfide in the hydrogen sulfide rich stream is greater than 55% by volume.

11. The enrichment apparatus of claim 1, further including a mixer operable to mix the hydrocarbon rich stream and the hydrogen sulfide rich stream into a feed stream for a furnace of the Claus unit.

12. The enrichment apparatus of claim 11, wherein the concentration of hydrogen sulfide in the feed stream for the furnace of the Claus unit is greater than 25% by volume.

13. A process for enriching a hydrogen sulfide concentration in an acid gas stream to create a hydrogen sulfide rich stream for feeding to a Claus unit, the process comprising the steps of:

feeding the acid gas stream to a hydrocarbon selective separation unit, the acid gas stream comprising hydrogen sulfide, carbon dioxide, and hydrocarbons;

separating the acid gas stream in the hydrocarbon selective separation unit to create a hydrocarbon rich stream and a purified acid gas stream, wherein the hydrocarbon rich stream comprises aromatics selected from the group consisting of benzene, toluene, ethyl benzene, and xylene;

feeding the purified acid gas stream to a hydrogen sulfide selective separation unit fluidly connected to the hydrocarbon selective separation unit, the hydrogen sulfide selective separation unit operable to separate the purified acid gas stream; and

separating the purified acid gas stream in the hydrogen sulfide selective separation unit to create the hydrogen sulfide rich stream and a hydrogen sulfide lean stream, the hydrogen sulfide rich stream having a concentration of hydrogen sulfide.

14. The process of claim 13, further comprising the steps of:

feeding the hydrogen sulfide rich stream to a carbon dioxide selective separation unit in fluid communication with the hydrogen sulfide selective separation unit, the carbon dioxide selective separation unit operable to separate the hydrogen sulfide rich stream;

separating the hydrogen sulfide rich stream to create a carbon dioxide rich permeate and a hydrogen sulfide rich retentate, the hydrogen sulfide rich retentate having a concentration of hydrogen sulfide; and

feeding the hydrogen sulfide rich retentate to the furnace of the Claus unit.

15. The process of claim 14, wherein the carbon dioxide selective separation unit is selected from the group consisting of an amorphous fluoroplastic membrane, an amorphous perfluoropolymer membrane, a random fluorocopolymer membrane, a perfluorinated copolymer membrane, and combinations thereof.

16. The process of claim 13, further comprising the steps of:

feeding the hydrogen sulfide rich stream to a second hydrogen sulfide selective separation unit fluidly connected to hydrogen sulfide selective separation unit, the second hydrogen sulfide selective separation unit operable to separate the hydrogen sulfide rich stream; and

separating the hydrogen sulfide rich stream in the second hydrogen sulfide selective separation unit to create an enriched hydrogen sulfide stream and a carbon dioxide retentate.

17. The process of claim 16, further comprising the steps of:

mixing the hydrocarbon rich stream and the enriched hydrogen sulfide stream to create a mixed furnace feed stream; and

feeding the mixed furnace feed stream to a furnace of the Claus unit.

18. The process of claim 17, wherein the mixed furnace feed stream has a hydrogen sulfide concentration of at least 25% by volume.

19. The process of claim 13, wherein the hydrogen sulfide selective separation unit is selected from the group consisting of polyphosphazene type polymer membranes, polyether-polyamide copolymer membranes, ionic liquid membranes, ionic liquid membrane contactors, and combinations thereof.

20. The process of claim 13, wherein the hydrocarbon selective separation unit comprises a PDMS type rubbery polymer membrane.

21. The process of claim 13, wherein the acid gas stream further comprises contaminants is selected from the group consisting of mercaptans, thiols, carbonyl sulfide, carbon disulfide, and combinations thereof.

22. The process of claim 13, wherein the hydrogen sulfide concentration in the acid gas stream is between 15% to 55% by volume.

23. The process of claim 13, wherein the hydrogen sulfide rich stream has a hydrogen sulfide concentration greater than 55% by volume.

24. An enrichment apparatus for enriching a hydrogen sulfide concentration in an acid gas stream to create a hydrogen sulfide rich stream for feed to a Claus unit, the enrichment apparatus comprising:

a hydrocarbon selective separation unit, the hydrocarbon selective separation unit operable to separate the acid gas stream into a hydrocarbon rich stream and a purified acid gas stream,

wherein the acid gas stream comprises hydrogen sulfide, carbon dioxide, and hydrocarbons,

wherein the hydrocarbon rich stream comprises aromatics selected from the group consisting of benzene, toluene, ethyl benzene, and xylene; and

a carbon dioxide selective separation unit in fluid communication with the hydrocarbon selective separation unit, the carbon dioxide selective separation unit operable to separate the purified acid gas stream to create a carbon dioxide rich stream and a carbon dioxide lean stream, the carbon dioxide lean stream having a concentration of hydrogen sulfide.

25. The enrichment apparatus of claim 24, further comprising:

a hydrogen sulfide selective separation unit in fluid communication with the carbon dioxide selective separation unit, the hydrogen sulfide selective separation unit operable to separate the carbon dioxide rich stream into a hydrogen sulfide rich permeate and a carbon dioxide rich retentate, the hydrogen sulfide rich permeate having a concentration of hydrogen sulfide.

26. A process for enriching a hydrogen sulfide concentration in an acid gas stream to create a hydrogen sulfide rich stream for feed to a Claus unit, the process comprising the steps of:

feeding the acid gas stream to a hydrocarbon selective separation unit, the acid gas stream comprising hydrogen sulfide, carbon dioxide, and hydrocarbons;

separating the acid gas stream in the hydrocarbon selective separation unit to create a hydrocarbon rich stream and a purified acid gas stream, wherein the hydrocarbon rich

stream comprises aromatics selected from the group consisting of benzene, toluene, ethyl benzene, and xylene;

feeding the purified acid gas stream to a carbon dioxide selective separation unit fluidly connected to the hydrocarbon selective separation unit, the carbon dioxide selective separation unit operable to separate the purified acid gas stream; and

separating the purified acid gas stream in the carbon dioxide selective separation unit to create a carbon dioxide rich stream and a carbon dioxide lean stream, the carbon dioxide lean stream having a concentration of hydrogen sulfide.

27. The process of claim 26, further including the step of:

feeding the carbon dioxide rich stream to a hydrogen sulfide selective separation unit fluidly connected to the carbon dioxide selective separation unit, the hydrogen sulfide selective separation unit operable to separate the carbon dioxide rich stream; and

separating the carbon dioxide rich in the hydrogen sulfide selective separation unit to produce a hydrogen sulfide rich permeate and a carbon dioxide rich retentate, the hydrogen sulfide rich permeate having a concentration of hydrogen sulfide.

28. The process of claim 26, wherein the acid gas stream further comprises contaminants is selected from the group consisting of mercaptans, thiols, carbonyl sulfide, carbon disulfide, and combinations thereof.

29. The process of claim 26, wherein the hydrogen sulfide concentration in the acid gas stream is between 15% to 55% by volume.

30. The process of claim 26, wherein the hydrogen sulfide rich stream has a hydrogen sulfide concentration greater than 55% by volume.