

CLAIMS:

1. A process for removing a target gas component from a gas mixture containing said target gas component and a second gas component, which process comprises:

a) conducting said gas mixture to a swing adsorption gas separation unit wherein the gas separation unit contains at least one adsorbent contactor comprising a gas inlet and a gas outlet, wherein the gas inlet and the gas outlet are in fluid connection by a plurality of open flow channels wherein the surfaces of the open flow channels are comprised of an adsorbent material that has a selectivity for said target gas component over said second gas component greater than 5, wherein the contactor has less than about 20% of its open pore volume in pores with diameters greater than about 20 angstroms and less than about 1 micron, and wherein at least a portion of said target gas component is adsorbed into said adsorbent material, thereby resulting in a product stream depleted of said target gas component;

b) collecting said the product stream;

c) desorbing the adsorbed gases from said adsorbent material, thereby resulting in a waste gas stream rich in said target gas component; and

d) collecting said waste gas stream.

2. The process of claim 1 wherein the gas mixture is a syngas containing CO, H₂, and at least one other gas component selected from the group consisting of CO₂, H₂S, CH₄, and N₂.

3. The process of any preceding claim wherein the target gas is selected from the group consisting of CO₂, H₂S, and N₂.

4. The process of any preceding claim wherein the adsorbent material is comprised of a structured adsorbent material selected from the group consisting of zeolites, titanosilicates, ferrosilicates, stannosilicates, aluminophosphate molecular sieves (AlPOs), and silicoaluminophosphate molecular sieves (SAPOs) and carbon molecular sieves.

5. The process of any preceding claim wherein the adsorbent material is comprised of an 8-ring zeolite that has a Si to Al ratio of about 1:1 to about 1000:1.

6. The process of claim 5 wherein the 8-ring zeolite is DDR.

7. The process of claim 5 wherein the 8-ring zeolite is selected from Sigma-1 and ZSM-58.

8. The process of any preceding claim wherein the adsorbent material is comprised of a zeolite selected from the group consisting of MFI, faujasite, MCM-41 and Beta.

9. The process of any preceding claim wherein the adsorbent contactor is comprised of a first adsorption zone comprising a first adsorbent material which is in fluid contact with a second adsorption zone comprising a second adsorbent material, wherein the composition of the first adsorbent material is different from the composition of a second adsorbent material.

10. The process of claim 9 wherein the first adsorbent material has a selectivity for the target gas component of the gas mixture over the second gas component greater than 5; the second adsorbent material has a selectivity for a third gas component over the second gas component greater than 5; and the second adsorbent material has a greater adsorption uptake for the third gas component than the first adsorbent material.

11. The process of any of claims 9-10 wherein the target gas component is CO₂, the second gas component is CH₄ and the third gas component is H₂S.

12. The process of any of claims 9-10 wherein the target gas component is N₂, the second gas component is CH₄ and the third gas component is H₂S.

13. The process of any preceding claim wherein the adsorbent contactor has less than about 15% of its open pore volume in pores with diameters greater than about 20 angstroms and less than about 1 micron.

14. The process of any preceding claim wherein the adsorbent contactor contains an effective amount of a thermal mass material having a higher capacity for adsorbing heat than the adsorbent material.

15. The process of any preceding claim wherein the adsorbent contactor contains both mesopores and macropores and wherein at least some of the mesopores and macropores are occupied with a blocking agent of an effective size that is small enough to fit into a mesopore but too large to fit into a micropore of the adsorbent material.

16. The process of claim 15 wherein the blocking agent is selected from the group consisting of polymers, microporous materials, solid hydrocarbons, and liquids.

17. The process of any preceding claim wherein the adsorbent contactor is a parallel channel contactor.

18. The process of any preceding claim wherein the target gas component is H₂S and the adsorbent material is comprised of a stannosilicate.

19. The process of any preceding claim wherein the adsorbent contactor is comprised of a first adsorption zone comprising a first adsorbent material which is in fluid contact with a second adsorption zone comprising a second

adsorbent material, wherein the composition of the first adsorbent material is different from the composition of a second adsorbent material.

20. The process of claim 19 wherein the first adsorbent material has a selectivity for the target gas component of the gas mixture over the second gas component greater than 5; the second adsorbent material has a selectivity for a third gas component over the second gas component greater than 5; and the second adsorbent material has a greater adsorption uptake for the third gas component than the first adsorbent material.

21. The process of any of claims 17-20 wherein the parallel channel contactor is in the form selected from: a) monolith comprised of a microporous adsorbent; b) a monolith formed from a non-adsorbent material but whose channels are lined with a microporous adsorbent; c) an array of hollow fibers comprised of a microporous adsorbent; and d) laminated sheets having an upper and lower face both of which are comprised of a microporous adsorbent.

22. The process of any of claims 17-21 wherein the channel gap of the open flow channels is from about 5 to about 1000 microns.

23. The process of any of claims 17-22 wherein the ratio of adsorbent volume to open flow channel volume is from about 0.5:1 to about 100:1.

CLAIMS

1. A process for removing a target gas component from a gas mixture containing said target gas component and a second gas component, which process comprises:

a) conducting said gas mixture to a swing adsorption gas separation unit wherein the gas separation unit contains at least one adsorbent contactor comprising a gas inlet and a gas outlet, wherein the gas inlet and the gas outlet are in fluid connection by a plurality of open flow channels wherein the surfaces of the open flow channels are comprised of an adsorbent material that has a selectivity for said target gas component over said second gas component greater than 5, wherein the contactor has less than about 20% of its open pore volume in pores with diameters greater than about 20 angstroms and less than about 1 micron, and wherein at least a portion of said target gas component is adsorbed into said adsorbent material, thereby resulting in a product stream depleted of said target gas component;

b) collecting said the product stream;

c) desorbing the adsorbed gases from said adsorbent material, thereby resulting in a waste gas stream rich in said target gas component; and

d) collecting said waste gas stream.

2. The process of claim 1 wherein the gas mixture is a syngas containing CO, H₂, and at least one other gas component selected from the group consisting of CO₂, H₂S, CH₄, and N₂.

3. The process of claim 2 wherein the target gas is selected from the group consisting of CO₂, H₂S, and N₂.

4. The process of claim 1 wherein the adsorbent material is comprised of a structured adsorbent material selected from the group consisting of zeolites, titanosilicates, ferrosilicates, stannosilicates, aluminophosphate molecular sieves

(AlPOs), and silicoaluminophosphate molecular sieves (SAPOs) and carbon molecular sieves.

5. The process of claim 1 wherein the adsorbent material is comprised of an 8-ring zeolite that has a Si to Al ratio of about 1:1 to about 1000:1.

6. The process of claim 5 wherein the 8-ring zeolite is DDR.

7. The process of claim 5 wherein the 8-ring zeolite is selected from Sigma-1 and ZSM-58.

8. The process of claim 1 wherein the adsorbent material is comprised of a zeolite selected from the group consisting of MFI, faujasite, MCM-41 and Beta.

9. The process of claim 1 wherein the adsorbent contactor is comprised of a first adsorption zone comprising a first adsorbent material which is in fluid contact with a second adsorption zone comprising a second adsorbent material, wherein the composition of the first adsorbent material is different from the composition of a second adsorbent material.

10. The process of claim 9 wherein the first adsorbent material has a selectivity for the target gas component of the gas mixture over the second gas component greater than 5; the second adsorbent material has a selectivity for a third gas component over the second gas component greater than 5; and the second adsorbent material has a greater adsorption uptake for the third gas component than the first adsorbent material.

11. The process of claim 10 wherein the target gas component is CO₂, the second gas component is CH₄ and the third gas component is H₂S.

12. The process of claim 10 wherein the target gas component is N₂, the second gas component is CH₄ and the third gas component is H₂S.

13. The process of claim 10 wherein the adsorbent material is comprised of a structured adsorbent material selected from the group consisting of zeolites, titanosilicates, ferrosilicates, stannosilicates, aluminophosphate molecular sieves (AlPOs), and silicoaluminophosphate molecular sieves (SAPOs) and carbon molecular sieves.

14. The process of claim 10 wherein the adsorbent material is comprised of an 8-ring zeolite that has a Si to Al ratio of about 1:1 to about 1000:1.

15. The process of claim 14 wherein the 8-ring zeolite is DDR.

16. The process of claim 14 wherein the 8-ring zeolite is selected from Sigma-1 and ZSM-58.

17. The process of claim 10 wherein the adsorbent material is comprised of a zeolite selected from the group consisting of MFI, faujasite, MCM-41 and Beta.

18. The process of claim 1 wherein the adsorbent contactor has less than about 15% of its open pore volume in pores with diameters greater than about 20 angstroms and less than about 1 micron.

19. The process of claim 1 wherein the adsorbent contactor contains an effective amount of a thermal mass material having a higher capacity for adsorbing heat than the adsorbent material.

20. The process of claim 1 wherein the adsorbent contactor contains both mesopores and macropores and wherein at least some of the mesopores and macropores are occupied with a blocking agent of an effective size that is small enough to fit into a mesopore but too large to fit into a micropore of the adsorbent material.

21. The process of claim 20 wherein the blocking agent is selected from the group consisting of polymers, microporous materials, solid hydrocarbons, and liquids.

22. The process of claim 1 wherein the adsorbent contactor is a parallel channel contactor.

23. The process of claim 3 wherein the adsorbent contactor is a parallel channel contactor.

24. The process of claim 13 wherein the adsorbent contactor is a parallel channel contactor.

25. The process of claim 22 wherein the adsorbent material is comprised of DDR having a Si to Al ratio of about 1:1 to about 1000:1.

26. The process of claim 24 wherein the adsorbent material is comprised of DDR having a Si to Al ratio of about 1:1 to about 1000:1.

27. The process of claim 22 wherein the adsorbent material is comprised of an 8-ring zeolite selected from Sigma-1 and ZSM-58 having a Si to Al ratio of about 1:1 to about 1000:1.

28. The process of claim 23 wherein the target gas component is H_2S and the adsorbent material is comprised of a stannosilicate.

29. The process of claim 22 wherein the adsorbent contactor is comprised of a first adsorption zone comprising a first adsorbent material which is in fluid contact with a second adsorption zone comprising a second adsorbent material, wherein the composition of the first adsorbent material is different from the composition of a second adsorbent material.

30. The process of claim 29 wherein the first adsorbent material has a selectivity for the target gas component of the gas mixture over the second gas component greater than 5; the second adsorbent material has a selectivity for a third gas component over the second gas component greater than 5; and the second adsorbent material has a greater adsorption uptake for the third gas component than the first adsorbent material.

31. The process of claim 30 wherein the target gas component is CO₂, the second gas component is CH₄ and the third gas component is H₂S.

32. The process of claim 30 wherein the target gas component is N₂, the second gas component is CH₄ and the third gas component is H₂S.

33. The process of claim 30 wherein the adsorbent contactor has less than about 15% of its open pore volume in pores with diameters greater than about 20 angstroms and less than about 1 micron.

34. The process of claim 33 wherein the adsorbent material is comprised of a structured adsorbent material selected from the group consisting of zeolites, titanosilicates, ferrosilicates, stannosilicates, aluminophosphate molecular sieves (AIPOs), and silicoaluminophosphate molecular sieves (SAPOs) and carbon molecular sieves.

35. The process of claim 34 wherein the parallel channel contactor is in the form selected from: a) monolith comprised of a microporous adsorbent; b) a monolith formed from a non-adsorbent material but whose channels are lined with a microporous adsorbent; c) an array of hollow fibers comprised of a microporous adsorbent; and d) laminated sheets having an upper and lower face both of which are comprised of a microporous adsorbent.

36. The process of claim 35 wherein the channel gap of the open flow channels is from about 5 to about 1000 microns.

37. The process of claim 35 wherein the ratio of adsorbent volume to open flow channel volume is from about 0.5:1 to about 100:1.