CLAIMS

1. A cyclical swing adsorption process for removing contaminants from a gaseous feed stream, the process comprising:

a) performing one or more adsorption steps, wherein each of the adsorption steps comprises passing a gaseous feed stream at a feed pressure and feed temperature through an adsorbent bed unit to remove one or more contaminants from the gaseous feed stream and to form a product stream that is passed to a cryogenic recovery system including a demethanizer;

b) performing one or more purge steps, wherein each of the purge steps comprises passing a purge stream through the adsorbent bed unit in a counter flow direction relative to the flow of the gaseous feed stream to form a purge product stream, wherein the purge stream comprises at least a portion of a demethanizer overhead stream from the demethanizer, wherein the purge pressure is between 40%+/- of the feed pressure;

c) performing one or more blowdown steps, wherein each of the blowdown steps comprises passing a blowdown outlet stream from the adsorbent bed unit to the feed stream, wherein the one or more blowdown steps reduce the pressure within the adsorbent bed unit by a predetermined amount to the feed pressure; and

d) repeating the steps a) to c) for at least one additional cycle.

2. The cyclical swing adsorption process of claim 1, wherein the purge stream comprises at least 20 volume % of the demethanizer overhead stream.

3. The cyclical swing adsorption process of claim 1, wherein the purge stream comprises at least 50 volume % of the demethanizer overhead stream.

4. The cyclical swing adsorption process of claim 1, wherein the purge stream comprises at least 95 volume % of the demethanizer overhead stream.

5. The cyclical swing adsorption process of claim 1, further comprising passing the purge product stream to sales gas, wherein the pressure of the purge output stream is within a range of 5% of a sales gas pressure of a sales gas stream.

6. The cyclical swing adsorption process of claim 1, wherein the purge pressure is between 20%+/- of the feed pressure.

7. The cyclical swing adsorption process of claim 1, wherein the purge pressure is in the range between the feed pressure and 40% greater than the feed pressure.

8. The cyclical swing adsorption process of claim 1, wherein the purge pressure is in the range between the feed pressure and 20% greater than the feed pressure.

9. The cyclical swing adsorption process of claim 1, wherein the purge stream is at a purge temperature within a range between 70°F and 450°F.

10. The cyclical swing adsorption process of claim 1, wherein the purge stream is at a purge temperature within a range between 70°F. and 300°F.

11. The cyclical swing adsorption process of claim 1, wherein the cycle duration is greater than 1 second and less than 1200 seconds.

12. The cyclical swing adsorption process of claim 1, wherein the gaseous feed stream is a hydrocarbon containing stream having greater than one volume percent hydrocarbons based on the total volume of the feed stream.

13. The cyclical swing adsorption process of claim 1, wherein the gaseous feed stream comprises hydrocarbons and H_2O, wherein the H_2O is one of the one or more contaminants and the gaseous feed stream comprises H_2O in the range of two parts per million molar to saturation levels in the gaseous feed stream.

14. The cyclical swing adsorption process of claim 1, wherein the gaseous feed stream comprises hydrocarbons and H_2O, wherein the H_2O is one of the one or more contaminants and the gaseous feed stream comprises H_2O in the range of 50 parts per million molar to 1,500 parts per million molar.

15. The cyclical swing adsorption process of claim 1, wherein the gaseous feed stream comprises hydrocarbons and CO_2, wherein the CO_2 is one of the one or more contaminants and the gaseous feed stream comprises CO_2 in the range between 0 molar percent and 5 molar percent of the total volume of the gaseous feed stream.

16. The cyclical swing adsorption process of claim 1, wherein the gaseous feed stream comprises hydrocarbons and the one or more contaminants comprising CO_2, wherein the CO_2 in the gaseous feed stream is less than the quantity of one minus the molar fraction of heavy hydrocarbons in the gaseous feed stream times a sales gas CO_2 maximum concentration specification.

17. The cyclical swing adsorption process of claim 1, wherein the feed pressure is in the range between 400 pounds per square inch absolute (psia) and 1,400 psia.

18. The cyclical swing adsorption process of claim 1, wherein the cycle duration is greater than 2 seconds and less than 600 seconds.

19. The cyclical swing adsorption process of claim 1, wherein water content in the product stream is in the range between 0.0 ppm and 5.0 ppm.

20. The cyclical swing adsorption process of claim 1, wherein the cryogenic recovery system is a cryogenic natural gas liquids recovery system.

21. The cyclical swing adsorption process of claim 1, wherein the cryogenic recovery system is a cryogenic controlled freeze zone recovery system.

22. The cyclical swing adsorption process of claim 1, wherein the adsorbent bed unit comprises an adsorbent material of Zeolite 3A, Zeolite 4A or Zeolite 5A.

23. A system for removing contaminants from a gaseous feed stream, the system comprising: one or more adsorbent bed units, wherein each of the one or more adsorbent bed units is configured to separate contaminants from a gaseous feed stream and to output a product stream, wherein the gaseous feed stream is provided at a feed temperature and a feed pressure; a cryogenic recovery system configured to receive the product stream and pass at least a portion of the product stream to a demethanizer to separate the at least a portion of the product stream into a final product stream and a demethanizer overhead stream, wherein the cryogenic recovery system comprises a gas/gas exchanger unit configured to receive the product stream from the adsorbent bed unit and to lower the temperature of the product stream by heat exchange with the at least portion of the demethanizer overhead stream to produce an exchanger output stream; and wherein a purge stream is configured

to be passed through the each of the one or more adsorbent bed units and comprises at least portion of the demethanizer overhead stream, wherein the purge pressure is between 40%+/- of the feed pressure.

24. The system of claim 23, further comprising: a glycol contactor unit configured to receive an input stream and to remove at least a portion of the water from the input stream; and a filter unit configured to receive a glycol output stream from the glycol contactor unit and to conduct away particulates and liquid droplets and to provide the feed stream to the one or more adsorbent bed units, wherein the gaseous feed stream is below saturation levels.

25. The system of claim 23, further comprising one or more conduits that are configured to pass a purge product stream from the one or more adsorbent bed units to a storage unit as a sales gas stream.

26. The system of claim 23, further comprising a subcooler unit configured to receive a portion of the exchanger output stream from the gas/gas exchanger unit and to adjust the temperature of the portion of the exchanger output stream to the desired temperature for the demethanizer by heat exchange with the at least portion of the demethanizer overhead stream.

27. The system of claim 23, further comprising a compressor configured to: receive the demethanizer overhead stream from the gas/gas exchanger unit; increase the pressure of the demethanizer overhead stream into a compressed demethanizer overhead stream; and provide the compressed demethanizer overhead stream to a regeneration adsorbent bed unit as the purge stream.

28. The system of claim 23, wherein the cryogenic recovery system is a cryogenic natural gas liquids recovery system.

29. The system of claim 23, wherein the cryogenic recovery system is a cryogenic controlled freeze zone recovery system.