CLAIMS

1. A processing unit comprising:

a housing forming an interior region;

a self-supporting structure disposed within the interior region, wherein the self-supporting structure has greater than 50% by weight of the active material in the self-supporting structure, wherein the self-supporting structure is an open-celled structure configured to provide one or more defined channels for fluid flow paths through the self-supporting structure;

a plurality of valves secured to the housing, wherein each of the plurality of valves is configured to control fluid flow along a flow path extending between the self-supporting structure and a location external to the housing;

wherein the self-supporting structure has a plurality of pores formed in the active material by removing a plurality of polyethylene spheres from the active material to form the plurality of pores.

2. The processing unit of claim 1, wherein the processing unit is a cyclical swing adsorbent bed unit configured to remove contaminants from a gaseous feed stream that passes through the one or more defined channels in the self-supporting structure.

3. The processing unit of claim 1 or claim 2, wherein the self-supporting structure has greater than 70% by weight of the active material in the self-supporting structure.

4. The processing unit of any one of claims 1 to 3, wherein the self-supporting structure has an inert support member coated by the active material in the self-supporting structure.

5. The processing unit of any one of claims 1 to 4, wherein the adsorbent bed unit further comprises a flow distributor disposed between the adsorbent bed and the plurality of

valves.

6. The processing unit of any one of claims 1 to 5, wherein the self-supporting structure has a layer of active material that is greater than 10 micrometers.

7. The processing unit of any one of claims 1 to 6, wherein the one or more defined channels comprise two or more channels that are substantially parallel.

8. A method for removing contaminants from a feed stream, the method comprising:

a) performing one or more adsorption steps in an adsorbent bed unit, wherein each of the one or more adsorption steps comprise: passing a gaseous feed stream through the self-supporting structure disposed in an interior region of a housing of the adsorbent bed unit to remove one or more contaminants from the gaseous feed stream, wherein the self-supporting structure has greater than 50% by weight of the active material in the self-supporting structure, wherein the self-supporting structure is an open-celled structure configured to provide one or more defined channels for fluid flow paths through the self-supporting structure;

b) performing one or more regeneration steps, wherein each of the one or more regeneration steps comprise conducting away at least a portion of the one or more contaminants in a contaminant output stream; and

c) repeating the steps a) to b) for at least one additional cycle;

wherein the self-supporting structure has a plurality of pores formed in the active material by removing a plurality of polyethylene spheres from the active material to form the plurality of pores.

9. The method of claim 8, wherein the method is a swing adsorption method and the cycle duration is for a period greater than 1 second and less than 600 seconds;

the gaseous feed stream is a hydrocarbon containing stream having greater than one volume percent hydrocarbons based on the total volume of the gaseous feed stream; and a

pressure of the gaseous feed stream is in the range between 400 pounds per square inch absolute (psia) and 1,400 psia.

10. The method of claim 8 or claim 9, wherein the performing one or more regeneration steps comprises performing one or more purge steps, wherein each of the one or more purge steps comprise passing a purge stream through the self-supporting structure to conduct away at least a portion of the one or more contaminants in the contaminant output stream.

11. The method of any one of claims 8 to 10, wherein performing the one or more adsorption steps is configured to lower the carbon dioxide (CO_2) level to less than 50 parts per million volume.

12. The method of any one of claims 8 to 11, wherein performing the one or more adsorption steps is configured to lower the water (H_2O) level to less than 105 parts per million volume.

13. The method of any one of claims 8 to 12, wherein the one or more defined channels comprise two or more channels that are substantially parallel.

14. A method of manufacturing a processing unit, the method comprising:

creating a template for a self-supporting structure;

disposing a mixture within the template, wherein the mixture comprises a plurality of polyethylene spheres; and

wherein the mixture has greater than 50% by weight of the active material in the self-supporting structure and the remaining mixture includes binder material;

curing the template and the mixture to form a self-supporting structure that is maintains a solid form;

wherein the curing the template and the mixture to form the self-supporting structure comprises removing the plurality of polyethylene spheres from the mixture to form the plurality of pores in the self-supporting structure;

removing the template from the self-supporting structure, wherein the self-supporting structure is an open-celled structure configured to provide one or more defined channels for fluid flow paths through the self-supporting structure, which are based on the template; and

disposing the self-supporting structure within housing of a processing unit having an interior region.

15. The method of claim 14, further comprising creating a three-dimensional model of the self-supporting structure having predetermined geometries for the one or more defined channels through the self-supporting structure.

16. The method of claim 15, further comprising creating a model of a template based on the three-dimensional model of the self-supporting structure.

17. The method of claim 16, further comprising printing a three-dimensional template based on the model of the template.

18. The method of any one of claims 14 to 17, wherein removing the template from the self-supporting structure further comprises heating the self-supporting structure and the template to decompose or melt the template and conduct away the melted template.

19. The method of any one of claims 14 to 18, further comprising vibrating the template and the mixture prior to curing the template and mixture to lessen any voids that may be formed between the template and mixture.

20. The method of any one of claims 14 to 19, wherein curing the template and the mixture further comprises sintering the binder material and active material into a cohesive solid structure that is the self-supporting structure.

21. The method of any one of claims 14 to 20, further comprising:

creating a plurality of valve ports into the housing; and

securing a valve to the housing in each of the plurality of valve ports to form a plurality of valves, wherein each of the plurality of valves is configured to control fluid flow between the self-supporting structure and a location external to the housing.

22. The method of claim 14, wherein the mixture comprises at least 5% polyethylene spheres.