CLAIMS

We claim:

1. A method of sorbing CO_2, comprising:

rotating a wheel framework structure that supports a sorbent bed, the sorbent bed comprising a support material comprising one or more monoliths and a sorbent having selectivity for sorption of CO_2 supported on the support material;

the support material comprising a first surface, a second surface, and a plurality of channels providing a flow path between a first surface of the support material and a second surface of the support material, at least a portion of the sorbent being supported on one or more surfaces within the plurality of channels;

exposing a first gas flow comprising 15 vol% to 25 vol% O_2 and 100 vppm to 650 vppm CO_2 to a first portion of the sorbent bed outside of the desorption zone volume, the first gas flow having a temperature of 0°C to 40°C;

exposing a plurality of gas flows to a second portion of the sorbent bed within the desorption zone volume, the desorption zone volume defined by at least one cover plate and one or more cover plate seals, the one or more cover plate seals providing a) a seal between the at least one cover plate and the first surface of the support material, b) a seal between the at least one cover plate and the second surface of the support material, or c) a combination thereof, the exposing a plurality of gas flows to the second portion of the sorbent bed comprising sequentially exposing the second portion of the sorbent bed to:

a purge gas flow to form a purge exhaust, and

a steam flow having a temperature of 80°C to 180°C to form a CO_2-containing output flow,

wherein the rotating of the wheel framework structure changes the portions of the sorbent bed that correspond to the first portion of the sorbent bed outside of the desorption zone volume and the second portion of the sorbent bed within the desorption zone volume.

2. The method of claim 1, wherein the desorption zone volume comprises a plurality of sub-zones, each sub-zone comprising at least one of the plurality of gas flows.

3. The method of claim 1, wherein exposing the second portion of the sorbent bed to the plurality of gas flows comprises exposing the second portion of the sorbent bed to the plurality of gas flows sequentially in time.

4. The method of claim 1, wherein exposing the plurality of gas flows to the second portion of the sorbent bed further comprises exposing the second portion of the sorbent bed to a temperature adjustment flow after the steam flow, the temperature adjustment flow having a temperature 0°C to 50°C to form a temperature adjustment flow exhaust.

5. The method of claim 4, wherein a temperature of a leading edge of the second portion of the sorbent bed is 70°C or higher after the exposing to the steam flow, and a temperature of a trailing edge of the second portion of the sorbent bed is 60°C or lower prior to being rotated out of the desorption zone volume.

6. The method of claim 4, wherein exposing the plurality of gas flows to the second portion of the sorbent bed further comprises exposing the second portion of the sorbent bed to a second purge gas flow after the temperature adjustment flow.

7. The method of claim 4, wherein the temperature adjustment flow comprises a humidity of 25% or less relative to the temperature of the temperature adjustment flow.

8. The method of claim 1, wherein exposing the second portion of the sorbent bed to the steam flow further forms a liquid output product, or wherein the steam flow comprises substantially no liquid water content, or a combination thereof.

9. The method of claim 1, wherein the desorption zone volume comprises at least one internal seal, the at least one internal seal providing a seal between an interior surface of the one or more cover plates and at least one of the first surface and the second surface of the support material, the at least one internal seal defining a plurality of sub-zones within the desorption zone volume.

10. The method of claim 1, wherein a pressure inside the desorption zone volume is greater than a pressure outside the desorption volume by 2.0 kPa or more.

11. The method of claim 1, wherein a pressure inside the desorption zone volume is lower than a pressure outside the desorption zone volume by 20 kPa or more.

12. The method of claim 1, wherein at least one sub-zone of the desorption zone volume is separated from the first portion of the plurality of channels by at least one internal seal and at least one cover plate seal.

13. The method of claim 1, wherein the first gas flow impinges on at least one surface of the at least one cover plate of the desorption zone, the average direction of flow for the first gas flow in the sorption zone being substantially orthogonal to the at least one surface of the at least one cover plate of the desorption zone.

14. The method of claim 1, wherein rotating the wheel framework structure comprises continuously rotating the wheel framework structure.