regeneration sector. One or more of the recycled isolation loops can be provided to reduce cross-contamination between sorption and desorption zones of rotor caused by pressure imbalances and large vapor pressure differences of the various fluid streams.

[0007] According to one aspect of the present disclosure, a method of reducing a sorbate concentration of a process fluid stream using a sorption bed system comprising a rotating mass of a regenerable sorbent material comprises the steps of rotating the sorbent mass so that, in a cycle of operation, a given volume of the sorbent mass sequentially passes through first, second, third, fourth, and fifth zones, before returning to the first zone; passing a process fluid stream through the sorbent mass in the first zone; passing a regeneration fluid stream through the sorbent mass in the third zone; and recycling an isolation fluid stream in a closed loop, independent of the process fluid stream and the regeneration fluid stream, between the sorbent mass in the fourth zone and in the second zone, wherein the regeneration fluid stream passes through the fifth zone before passing through the third zone.

[0008] According to another aspect of the present disclosure, a rotary sorption bed system comprises a rotating sorbent mass of a regenerable sorbent material, in a cycle of operation, a given volume of the sorbent mass sequentially passing through first, second, third, fourth, and fifth zones, before returning to the first zone; a process fluid stream directed through the first zone; a regeneration fluid stream directed through the third zone; and an isolation fluid stream that recirculates in a closed loop independent of the process fluid stream and the regeneration fluid stream through the second and fourth zones, wherein the regeneration fluid stream passes through the fifth zone before passing through the third zone.

[0009] As used herein, “cycle of operation” means a path of movement of the sorbent mass during which the sorbent mass undergoes both a sorption and desorption process. The term “sequentially” refers to a relative order, but does not necessarily require that one immediately follow another. In this embodiment, for example, even if another zone were interposed between the first zone and the second zone, it would still be

What is claimed is:

1. A method of reducing a sorbate concentration of a process fluid stream using a sorption bed system comprising a rotating mass of a regenerable sorbent material, the method comprising the steps of:

rotating the sorbent mass so that, in a cycle of operation, a given volume of the sorbent mass sequentially passes through first, second, third, fourth, and fifth zones, before returning to the first zone;

passing a process fluid stream through the sorbent mass in the first zone; passing a regeneration fluid stream through the sorbent mass in the third zone; and

recycling an isolation fluid stream in a closed loop, independent of the process fluid stream and the regeneration fluid stream, between the sorbent mass in the fourth zone and in the second zone,

wherein the regeneration fluid stream passes through the fifth zone before passing through the third zone.

2. The method of claim 1, wherein the direction of fluid flow in each of the first, fourth, and fifth zones is the same.

3. The method of claim 2, wherein the direction of fluid flow in each of the second and third zones is the same.

4. The method of claim 3, wherein the direction of fluid flow in each of the first, fourth, and fifth zones is opposite the direction of fluid flow in each of the second and third zones.

5. The method of claim 1, wherein a concentration of at least one member selected from the group consisting of water vapor, volatile organic compounds, and nitrous oxides is reduced as a result of passing the process fluid stream through the sorbent mass in the first zone.

6. The method of claim 1, further comprising the steps of:

recirculating the regeneration fluid stream in a closed loop by first passing the regeneration fluid stream through the fifth zone; and

heating the regeneration fluid stream after exiting the fifth zone and prior to passing the regeneration fluid stream through the third zone.

7. The method of claim 1, further comprising the step of recirculating the process fluid stream in a substantially closed loop to dehydrate or maintain dryness of a product.

8. A rotary sorption bed system, comprising:

a rotating sorbent mass of a regenerable sorbent material, in a cycle of operation, a goven colume of the sorbent mass sequentially passes through first, second, third, fourth, and fifth zones, before returning to the first zone;

a process fluid stream directed through the first zone;

a regeneration fluid directed through the third zone; and

an isolation fluid stream that recirculates in a closed loop independent of the process fluid stream and the regeneration fluid stream through the second and fourth zones,

wherein the regeneration fluid stream passes through the fifth zone before passing through the third zone.

9. The system of claim 8, wherein the process fluid stream and the regeneration fluid stream are passed through the sorbent mass in opposite directions, and the isolation fluid stream is passed through the sorbent mass in the same direction as the fluid stream immediately following the isolation fluid stream with respect to the direction of rotation of the sorbent mass.

10. The system of claim 8, further comprising a heating device disposed in the regeneration fluid stream between the fifth zone and the third zone so as to further heat the regeneration fluid stream before passing through the third zone.

11. The system of claim 8, wherein the process fluid stream is at a higher pressure than the regeneration fluid stream.

12. The system of claim 8, wherein the process fluid stream is at a lower pressure than the regeneration fluid stream.

13. The system of claim 8, wherein the process fluid stream is recirculated in a substantially closed loop to dehydrate or maintain dryness of a product.