CLAIMS

1. A method for separating a feed stream in a distillation tower comprising:

maintaining a controlled freeze zone section in the distillation tower, wherein the controlled freeze zone section is constructed and arranged to form a plurality of solids and a hydrocarbon-enriched vapor stream from the feed stream;

maintaining a melt tray assembly within the controlled freeze zone section, wherein the melt tray assembly is constructed and arranged to at least partially melt the solids that are formed in the controlled freeze zone section, and wherein the melt tray assembly comprises a heat exchange mechanism comprising a plurality of plates having one or more hollow tubings forming an integral part of the plates, and further wherein the heat exchange mechanism comprises a plurality of passages in at least one of the plurality of plates, said passages allowing equilibration of liquid surrounding the at least one plate;

at least partially melting the solids using the heat exchange mechanism by flowing a heating medium through the one or more hollow tubings that are integrally disposed in the plates of the heat exchange mechanism, wherein the heating medium is at a higher temperature than the temperature of the solids;

collecting the solids that have been at least partially melted by the heat exchange mechanism; and

separating the at least partially melted solids from the hydrocarbon-enriched vapor stream.

2. The method of claim 1, wherein at least one of the plurality of plates is substantially rectangular in shape.

3. The method of claim 1, wherein at least one of the plurality of plates is conical in shape.

4. The method of claim 1, wherein at least one of the plurality of plates is frusto-conical in shape.

5. The method of claim 1, wherein the plurality of plates are concentrically arranged, with each of the plurality of plates having a different radius of curvature.

6. The method of claim 1, wherein at least one of the plurality of plates is formed in a spiral.

7. The method of any one of claims 1-6, wherein the plurality of plates comprises a plurality of interconnected sets of plates.

8. The method of any one of claims 1-7, wherein at least one of the plurality of plates is disposed to accommodate passage of at least one vapor riser adjacent thereto.

9. The method of claim 8, wherein the at least one vapor riser comprises a plurality of vapor risers, at least one of the plurality of vapor risers having a length different from a length of another of the at least one of the plurality of vapor risers.

10. The method of claim 8, wherein the at least one vapor riser has an interior, and further comprising an irregular texture or shape in the interior of the vapor riser.

11. The method of any one of claims 1-10, wherein a surface of at least one of the plurality of plates is textured for enhanced heat transfer performance.

12. The method of any one of claims 1-11, wherein an inner surface of the hollow tubing is textured.

13. The method of any one of claims 1-12, wherein at least one of the one or more hollow tubings has an orientation of one or more of circumferential, radial, angled, parallel to a diameter of the distillation tower, and perpendicular to the diameter of the distillation tower.

14. The method of any one of claims 1-13, further comprising:

selecting a solid from the plurality of solids in the controlled freeze zone, wherein at least one of the plurality of solids has a different melting temperature than the melting temperature of the selected solid; and

controlling the higher temperature such that the selected solid at least partially melts and the at least one of the plurality of solids does not.

15. A method for producing hydrocarbons comprising:

maintaining a controlled freeze zone section in the distillation tower that receives a freezing zone liquid stream to form a solid and a hydrocarbon-enriched vapor stream in the controlled freeze zone section;

melting at least a portion of the solid using a heat exchange mechanism comprising a plurality of plates having one or more hollow tubings forming an integral part of the plates, and further wherein the heat exchange mechanism comprises a plurality of passages in at least one of

the plurality of plates, said passages allowing equilibration of liquid surrounding the at least one plate, wherein melting comprises:

heating a heating medium to a higher temperature than the temperature of the solid;

flowing the heating medium through a hollow tubing integrally disposed in at least one plate positioned where the solid forms within the controlled freeze zone section,

collecting the solid that has been at least partially melted by the heat exchange mechanism;

disposing of the at least partially melted solid; and

passing the hydrocarbon-enriched vapor stream from the distillation tower.

16. The method of claim 1, wherein the heat exchange mechanism comprises a plurality of individual, interconnected heat-exchangers, each of the plurality of individual, interconnected heat-exchangers including portion of the plurality of plates.

17. The method of claim 16, wherein the plurality of heat-exchangers are arranged in a substantially parallel, coiled, or serpentine configuration.

18. The method of any one of claims 1-14, wherein the melt tray assembly further comprises a plurality of vapor risers, and wherein at least partially melting the solids further comprises passing vapor through at least one of the plurality of vapor risers.