METHOD AND APPARATUS FOR CONTROLLING TEMPERATURE OF A FREEZE PLATE

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ABSTRACT
A freeze plate is provided. The freeze plate includes a freeze plate surface, a sealed chamber adjacent the freeze plate surface, one or more refrigerant lines in said sealed chamber, and a fluid in said sealed chamber in thermal contact with the freeze plate surface and the one or more refrigerant lines.
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CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The following application claims priority to U.S. Provisional Application No. 60/840,885, filed on Aug. 29, 2006.

BACKGROUND OF THE DISCLOSURE

[0002] 1. Field of the Disclosure

[0003] This disclosure relates generally to refrigeration and, more particularly, a method and apparatus for controlling temperature of a freeze plate.

[0004] 2. Description of the Related Art

[0005] In the food service industry, food products may be placed on a cooled surface, otherwise known as a freeze plate, to prevent reduction of a temperature of the food product below a predetermined temperature. For example, the cooled surface may prevent ice cream from melting prior to serving and allow for mixing of additional ingredients to produce different flavors of ice cream. The temperature of such cooled surfaces, however, is difficult to maintain when exposed to a heat load, such as a food product having a higher temperature than the cooled surface. Thus, additional refrigeration system capacity, or a solid material mass on the cooled surface such as an aluminum plate, granite slab or other conductive material, to provide a heat sink, is necessary to maintain the temperature of the freeze plate. However, such a solid material mass on the cooled surface may be undesirably difficult to cool, leading to inefficiency and increased cost.

[0006] Accordingly, there is a need for an improved method and apparatus for controlling a temperature of a freeze plate. There is also a need for an improved method and apparatus for controlling a temperature of a freeze plate while applying a varying heat load to a surface of the freeze plate.

SUMMARY OF THE DISCLOSURE

[0007] A freeze plate is provided. The freeze plate includes a freeze plate surface, a sealed chamber adjacent the freeze plate surface, one or more refrigerant lines in the sealed chamber, and a fluid in the sealed chamber in thermal contact with the freeze plate surface and the one or more refrigerant lines.

[0008] The above-described and other features and advantages of the present disclosure will be appreciated and understood by those skilled in the art from the following detailed description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 schematically depicts a side cross-sectional view of a freeze plate of the present disclosure; and

[0010] FIG. 2 schematically depicts a top perspective view of the freeze plate of FIG. 1.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0011] Referring now to FIGS. 1 and 2, an exemplary embodiment of a freeze plate generally referred to by reference numeral 10 is illustrated. Freeze plate 10 has a temperature that may be controlled while applying a varying heat load to the surface.

[0012] Freeze plate 10 has a freeze plate surface 12. The freeze plate surface 12 is a thermally conductive material. One or more food products may be cooled on a freeze plate surface 12. The size and shape of freeze plate surface 12, as well as a configuration on freeze plate 10, can vary with the particular needs of freeze plate 10. Such factors as sizing, mobility, refrigeration needs, and others can be used by one of ordinary skill in the art to determine the particular size and shape of freeze plate surface 12, as well as the configuration on freeze plate 10. In one embodiment, freeze plate surface 12 has a planar, rectangular shape for the placement of food products. The material of freeze plate surface 12 that is utilized can vary according to the particular needs of freeze plate 10, to maximize heat transfer. In one embodiment, the freeze plate is made of stainless steel, aluminum, or any thermally conductive material. The freeze plate 10 may have a width W1 that may be any length or width.

[0013] Freeze plate 10 has a sealed chamber 14. Sealed chamber 14 is filled with a fluid 16. Fluid 16 comes into contact with at least a portion of freeze plate surface 12. In one embodiment, fluid 16 contacts the entire freeze plate surface 12. Fluid 16 can be at least one fluid selected from the group consisting of: glycol, gel, water, foam, superabsorbent polymer, cellulose ether, a water-based solution, and a water-based solution containing carboxyl methyl cellulose. In one embodiment, fluid 16 has a freezing point at or near a desired temperature of freeze plate surface 12. In another embodiment, fluid 16 has a freezing point that is about 0°F. (degrees Fahrenheit) to about 10°F. The freezing point of fluid 16, being at or near the desired temperature of freeze plate surface 12, leverages energy stored and given off during a phase change of fluid 16 to a solid.

[0014] One or more refrigerant lines 18 are in thermal contact with fluid 16. In one embodiment, refrigerant lines 18 are suspended in fluid 16. The one or more refrigerant lines chill or cool fluid 16. Refrigerant lines 18 can be a cylindrical shaped tubing that has a refrigerant fluid disposed therein. Refrigerant lines 18 may abut a bottom surface 19 of freeze plate surface 12. The refrigerant fluid may be a coolant such as an R22 refrigerant, an R134 refrigerant, an R407a refrigerant, or any other coolant or fluid that may be heated or cooled. The fluid may be circulated in refrigerant lines 18 through a cooling device 20. Thus, heat transfer may occur between fluid 16 and freeze plate surface 12, fluid 16 and refrigerant lines 18, and/or refrigerant lines 18 and freeze plate surface 12.

[0015] Freeze plate 10 may have a temperature control sensor 22. The temperature control sensor 22 is inserted directly into fluid 16 to detect a temperature of fluid 16. The temperature control sensor 22 can be in communication with a temperature control system 30, to regulate flow of refrigerant into refrigerant lines 18. The temperature control system 30 may be a controller, such as a microprocessor and/or the like. Thus, temperature control sensor 22 and temperature control system 30 may closely control the temperature of the freeze plate 10 while a varying heat load is applied to freeze plate surface 12.

[0016] Sealed chamber 14 may have walls that are, such as, for example, stainless steel, aluminum, and the like. The sealed chamber 14 may have a width W2 that may be any size. The sealed chamber 14 may have a bottom wall 24 and
side walls 26 that are insulated. The bottom wall 24 and side walls 26 may be insulated with insulation 27 made of polyurethane foam or other known insulators. The insulation provides isolation from ambient conditions, and may further help to control the temperature of fluid 16 and freeze plate 10.

[0017] Sealed chamber 14 may have an elevated portion 28 having a height greater than freeze plate surface 12. The elevated portion 28 provides a place for any air in sealed chamber 14 to accumulate. The elevated portion 28 allows an entire horizontal length of freeze plate surface 12 to contact fluid 16 to maximize heat transfer therebetween.

[0018] The freeze plate 10 may be disposed in a counter type structure. Preferably, the counter type structure has cooling device 20 therein. The cooling device 20 may be removable or formed in an integral manner with the freeze plate 10. One skilled in the art should appreciate that cooling device 20 may be any heating or cooling device known in the art, such as, for example, a vapor compression circuit.

[0019] For example, food products may be placed on freeze plate 10. The food products, such as ingredients for ice cream, are frozen by freeze plate 10. In contrast, prior art cooled surfaces require placing already frozen ice cream on a cooled surface due to difficulty in maintaining temperature of the cooled surface without adding additional refrigeration system capacity. Additional food product ingredients may be added to the ice cream and mixed for different flavors at a predetermined temperature on freeze plate 10. The ice cream may maintain the predetermined temperature on freeze plate 10 and then be served at the predetermined temperature to consumers. Thus, freeze plate 10 may closely control the temperature of the freeze plate 10 while applying a varying heat load to freeze plate surface 12 and improve efficiency and cost over the prior art.

[0020] While the instant disclosure has been described with reference to one or more exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope thereof. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the disclosure without departing from the scope thereof. Therefore, it is intended that the disclosure not be limited to the particular embodiment(s) disclosed as the best mode contemplated for carrying out this disclosure.

What is claimed is:

1. An apparatus for cooling a food product, comprising: a plate for holding the product, wherein the product is placed on a first side of said plate; a chamber connected to said plate; a fluid disposed within said chamber, and at least one refrigerant line in contact with said fluid, wherein a coolant flows through said refrigerant line, and said fluid is in contact with at least a portion of a second side of said plate.

2. The apparatus of claim 1, wherein said fluid contacts all of said second side of said plate.

3. The apparatus of claim 2, wherein said chamber has an elevated portion that is higher than said first surface of said plate.

4. The apparatus of claim 1, wherein said refrigerant line is suspended in said fluid.

5. The apparatus of claim 1, wherein said refrigerant line abuts said second side of said plate.

6. The apparatus of claim 1, further comprising a temperature sensor disposed within said fluid, to measure a temperature of said fluid.

7. The apparatus of claim 7, further comprising a controller in communication with said temperature sensor, wherein said controller regulates the flow of said coolant through said refrigerant line.

8. A method of controlling the temperature of a freeze plate, the method comprising the steps of: supplying a flow of a coolant through at least one refrigerant tube, wherein said refrigerant tube is in contact with a fluid; measuring a temperature of said fluid, and adjusting said flow of said coolant based on said temperature of said fluid, wherein said fluid and said refrigerant tube are disposed within a chamber, and said chamber is connected to the freeze plate, so that said fluid contacts at least a portion of the freeze plate.

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