

VACUUM INSULATION FOR AN INTEGRATED REFRIGERATED CONTAINER

FIELD OF INVENTION

[0001] This invention relates generally to a transport refrigeration system and, more particularly, to vacuum insulation bags to be used with blown polyurethane foam to increase the insulation properties of an integrated refrigerated container.

DESCRIPTION OF RELATED ART

[0002] Products such as produce, meat and the like being shipped relatively long distances are conventionally placed within refrigerated containers. These refrigerated containers are specifically designed for conditioning an interior space with a temperature for the products for an extended period of time. The refrigerated containers utilize a transport refrigeration unit for cooling these products during transport. The refrigeration unit is typically secured to the front wall of the refrigerated container and circulates cooled air inside the interior space through evaporator fans which direct the air from the front of the container to the rear.

[0003] Generally, insulation and air leakage is a concern when shipping produce and meat in these refrigerated containers. Typically, refrigerated containers use polyurethane cell foam technology that is injected into the gap separating the outer wall from the inner liner. The polyurethane foam is used for both its insulation properties as well as for its structural integrity. But, air leakage and heat transfer is still an issue when using the polyurethane foam. An insulation technology is required that will overcome the drawbacks of the current cell foam technology being utilized.

BRIEF SUMMARY

[0004] According to one aspect of the invention, an insulation system for a cargo container includes at least one wall having an exterior panel and an interior liner, the exterior panel and the interior liner being substantially parallel to each other; a cavity disposed between the exterior panel and the interior liner, the cavity being coextensive with a surface area of each of the exterior panel and the interior liner; and at least one vacuum insulation bag disposed within the cavity, the at least one vacuum insulation bag being configured for insulating the interior liner from the exterior panel.

[0005] According to another aspect of the invention, a method for insulating a cargo container includes providing at least one wall having an exterior panel and an interior liner, the exterior panel and the interior liner being coextensive to each other; and positioning at least one vacuum insulation bag within a cavity, the at least one vacuum insulation bag being configured for insulating the interior liner from the exterior panel. Also, the cavity is disposed between the exterior panel and the interior liner, the cavity being coextensive with a surface area of each of the exterior panel and the interior liner.

[0006] Other aspects, features, and techniques of the invention will become more apparent from the following description taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0007] Referring now to the drawings wherein like elements are numbered alike in the FIGURES:

[0008] FIG. 1 illustrates a perspective view of an integrated container with a refrigeration system according to an embodiment of the invention;

[0009] FIG. 2 illustrates schematic top view of a cross-section of the side wall of the integrated container according to an embodiment of the invention; and

[0010] FIG. 3 illustrates a top view of a cross-section of the side wall of the integrated container but with reinforcement members inserted within the side wall according to an embodiment of the invention.

DETAILED DESCRIPTION

[0011] Embodiments of an insulated integrated refrigerated container include walls that are formed from an inner liner and an exterior panel and enclose one or more vacuum insulation bags. In embodiments, the vacuum insulated bags are confined or sandwiched within a cavity provided between each of an exterior panel and inner liner, side and rear walls, roof, and floor or in combination with other commonly used insulation materials for improving the insulation properties of insulated integrated refrigerated container. In an embodiment, the vacuum insulation bags are attached to an interior surface of the exterior panel and can be held in place with polyurethane foam having a blowing agent that fills the cavity after the vacuum insulation bags are attached. Other embodiments include reinforcing members when

polyurethane foam is not utilized for structural support. In one example, the vacuum insulated bags use a polyurethane foam as a core material, however, but it is contemplated that other core materials can be used.

[0012] Referring now to the drawings, FIG. 1 illustrates an integrated refrigerated container 100 including a cargo container 105 coupled to a refrigeration system 110 according to an embodiment of the invention. The integrated refrigerated container 100, which is shown formed into a generally rectangular construction, and includes opposed side walls 115, a front wall 120, a top wall 125, a directly opposed bottom wall 130, and a door or doors (not shown) attached on hinges at the rear end 135. The walls 115-130 may be formed from an inner liner and an exterior panel (shown in FIG. 2) comprising for example welded corrugated steel or aluminum in order to provide significant strength and structural integrity. In an example, the integrated refrigerated container 100 may be approximately twenty feet in length, with a width and height of approximately eight feet. However, these dimensions may vary depending on the particular environment in which the integrated refrigerated container 100 is utilized. The refrigeration system 110 is integrated into a front cavity 140 within the cargo container 105. The front cavity 140 houses components of the refrigeration system 110, which is provided for cooling an interior space (not shown) enclosed by walls 115-130 and the door or doors (not shown).

[0013] FIG. 2 illustrates a schematic top view of a cross-section of the side wall 115 of the integrated refrigerated container 100 including at least one vacuum insulation bag 210 according to an embodiment of the invention. The side wall 115 may include an exterior sheet metal panel 205, adjacent to the ambient environment, and an interior liner 215, adjacent to the interior space being conditioned. The exterior panel 205 and interior liner 215 cooperate to enclose a cavity 220 that is generally coextensive with the surface area of the panel 205 and the liner 215. The exterior panel 205 may be formed of sheet aluminum while the inner liner may include a resin impregnated fiber panel, or the like. Also, the side wall 115 may include a plurality of substantially similar vacuum insulation bags such as, for example, the vacuum insulation bag 210 that is confined or sandwiched within the cavity 220. The plurality of vacuum insulation bags 210 are inserted into the cavity 220 along an interior surface of the exterior panel 205 and held in place with insulating material such as, for example, polyurethane foam 225 having a blowing agent that is “foamed-in” the cavity 220 after one or more of the vacuum insulation

bags 210 is attached. The polyurethane foam 225 expands upon curing and fills the areas surrounding the vacuum insulation bags 210 within the cavity 220. The vacuum insulation bag 210 may be attached to the interior surface for example with pins, nails, screws, tape, glue, or other similar types of materials prior to filling the cavity with polyurethane foam 225. In embodiments, one or more vacuum insulation bags 210 may be utilized within cavities formed between the interior liner 215 and each of the side walls 115 (FIG. 1), the front wall 120 (FIG. 1), the top wall 125 (FIG. 1), and the bottom wall 130 (FIG. 1) that are held in place with insulating material such as, for example, polyurethane foam 225 having a blowing agent that is “foamed-in” into the cavities to hold the insulation bags 210 in place.

[0014] The vacuum insulation bag 210 may include a substantially gas-tight barrier film or outer layer surrounding a rigid core or filler insulation from which air has been evacuated. The barrier film may be made of a non-permeable wall that prevents air from entering the vacuum insulation bag 210 while the filler or core is a rigid and highly-porous material to support the barrier film once the air has been evacuated. In a non-limiting example, the filler is polyurethane foam, fumed silica, aerogel or glass fiber, however, other materials for the filler may be utilized without departing from the scope of the invention. A gas absorbent (also referred to as “getter”) may be added to the filler material to collect gases leaked through the barrier film or offgassed from the barrier film. The barrier film may be formed into a pouch into which the filler material is inserted. A vacuum is applied to the bag 210 in order to evacuate air from the core material after which the barrier film is heat sealed to form the bag 210. In an example, a plurality of polymeric film layers are used as the edge layers having an inner metalized or aluminum layer with a thickness of, in one non-limiting example, 23 microns may be used. In some non-limiting examples, the vacuum insulation bag 210 having a length of about 2 feet (0.6096 meter), a width of about 2 feet (0.6096 meter) or 4 feet (1.2192 meter), and a thickness in the range of about 10 millimeter to about 25 millimeter may be utilized, however, other vacuum insulation bags 210 of various sizes may be utilized. In one embodiment, the width (distance from the exterior panel 205 to the interior liner 215) may be decreased in order to provide a closer fit with the vacuum insulation bags 210. It is to be appreciated that the polyurethane foam 225 provides structural integrity to the side wall 115 by supporting the exterior panel 205 to the inner liner 215 in addition to providing insulation properties between exterior panel 205 and inner liner 215.

[0015] In an embodiment, illustrated in FIG. 3, the side wall 115 includes a plurality of vacuum insulation bags 310 without polyurethane foam according to an embodiment of the invention. The embodiment in FIG. 3 is substantially the same as the embodiment in FIG. 2 with the principal exception that the side wall 115 includes an exterior panel 305 and an interior liner 315 supported by a plurality of substantially similar reinforcing members 325. The reinforcing members 325 are, in an embodiment, made from aluminum or stainless steel structural members that reinforce the connection between the exterior panel 305 and the interior liner 315. Further, the exterior panel 305 and the inner liner 315 cooperate to enclose a cavity 320, which is generally coextensive with the surface area of the panel 305 and the liner 315. Further, side wall 115 includes a plurality of vacuum insulation bags such as, for example, vacuum insulation bag 310 that is confined or sandwiched within the cavity 320 and attached to the interior surface of exterior panel 305 for example with pins, nails, screws, tape, glue, or other similar types of materials. One or more vacuum insulation bags 310 may be utilized within cavities formed between the interior liner 315 and each of side walls 115 (FIG. 1), the front wall 120 (FIG. 1), the top wall 125 (FIG. 1), and bottom wall 130 (FIG. 1) that are held in place with pins, nails, screws, tape, glue, or other similar types of materials. The vacuum insulation bag 310 is substantially the same as the vacuum insulation bag 210 that is shown and described in FIG. 2. In one embodiment, the width (distance from exterior panel 305 to interior liner 315) may be decreased in order to provide a closer fit with the vacuum insulation bags 310.

[0016] The technical effects and benefits of embodiments relate to an integrated refrigerated container having one or more vacuum insulation bags. The vacuum insulation bags are confined or sandwiched within a cavity provided between the outer panel and inner liner forming the walls of the container. The vacuum insulation bags are attached to the interior surface of the exterior panel and held in place with polyurethane foam having a blowing agent that is filled into the cavity after the vacuum insulation bags are attached. Other embodiments include reinforcing members when polyurethane foam is not utilized for structural support.

[0017] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. While the description of the present invention has been presented for purposes of illustration and description, it is not intended to be exhaustive or limited to the invention in the

form disclosed. Many modifications, variations, alterations, substitutions, or equivalent arrangement not hereto described will be apparent to those of ordinary skill in the art without departing from the scope and spirit of the invention. Additionally, while various embodiment of the invention have been described, it is to be understood that aspects of the invention may include only some of the described embodiments. Accordingly, the invention is not to be seen as limited by the foregoing description, but is only limited by the scope of the appended claims.

CLAIMS

1. An insulation system for a cargo container, comprising:
at least one wall having an exterior panel and an interior liner, the exterior panel and the interior liner being substantially parallel to each other;
a cavity disposed between the exterior panel and the interior liner, the cavity being coextensive with a surface area of each of the exterior panel and the interior liner; and
at least one vacuum insulation bag disposed within the cavity, the at least one vacuum insulation bag being configured for insulating the interior liner from the exterior panel.
2. The system of claim 1, further comprising expandable polyurethane foam disposed within the cavity, the polyurethane foam expanding around the at least one vacuum insulation bag upon curing.
3. The system of claim 1, further comprising a plurality of reinforcing members coupled to each of the exterior panel and the inner liner.
4. The system of claim 3, wherein the plurality of reinforcing members are orthogonally coupled to interior surfaces of each of the exterior panel and the inner liner.
5. The system of claim 1, wherein the exterior panel is adjacent to an ambient environment.
6. The system of claim 1, wherein the interior liner is adjacent to an interior space being conditioned.
7. The system of claim 1, wherein the at least one vacuum insulation bag is coupled to an interior surface of the exterior panel with at least one of pins, nails, screws, tape, or glue.
8. The system of claim 1, wherein the at least one vacuum insulation bag includes a barrier film enclosing an insulating material.
9. The system of claim 8, wherein the insulating material is one of a polyurethane foam, fumed silica, aerogel, and glass fiber.
10. A method for insulating a cargo container, comprising:
providing at least one wall having an exterior panel and an interior liner, the exterior panel and the interior liner being coextensive to each other; and

positioning at least one vacuum insulation bag within a cavity, the at least one vacuum insulation bag being configured for insulating the interior liner from the exterior panel;

wherein the cavity is disposed between the exterior panel and the interior liner, the cavity being coextensive with a surface area of each of the exterior panel and the interior liner.

11. The method of claim 10, further comprising inserting expandable polyurethane foam within the cavity, wherein the expandable polyurethane foam expands upon curing to fill the cavity.

12. The method of claim 10, further comprising coupling a plurality of reinforcing members to each of the exterior panel and the inner liner.

13. The method of claim 12, wherein the plurality of reinforcing members are orthogonally coupled to interior surfaces of each of the exterior panel and the inner liner.

14. The method of claim 10, wherein the exterior panel is adjacent to an ambient environment.

15. The method of claim 10, wherein the interior liner is adjacent to an interior space being conditioned.

16. The method of claim 10, further comprising coupling the at least one vacuum insulation bag to an interior surface of the exterior panel with at least one of pins, nails, screws, tape, or glue.

17. The method of claim 10, wherein the at least one vacuum insulation bag includes a barrier film enclosing an insulating material.

18. The method of claim 17, wherein the insulating material is one of polyurethane foam, fumed silica, aerogel, and glass fiber.