NON-CONTACT INSULATION TANK PANEL SYSTEM AND METHOD OF FABRICATING THE SAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is directed to an insulation system and in particular to a non-contact insulation panel system for storage tank or the like. Such non-contact insulation panel system decreases chances of corrosion under insulation (CUI).

2. Description of the Prior Art

In industries, it is often desired to thermally insulate generally cylindrical tanks or containers or the like such as storage towers or tanks which have outer convex curved surfaces. Oftentimes, there is a need to provide these tanks, towers or containers with good insulation, allow long-term maintenance-free thermal control of large bulk storage tanks in chemicals, oil and gas. It is frequently desired to insulate such tanks, towers or containers to prevent solidification of the contents or to maintain the contents at a desirably low viscosity. Good and effective insulation has become particularly desirable and economically feasible for such installations. Storage tanks and towers from three meters or larger in diameter that require thermal conservation or condensation control are perfect in tank panel system.

U.S. Patent No. 3,948,412, discloses the use of welded studs to maintain insulating panels in place on the exterior surface of a tank, which overcomes some of the problems encountered with exterior banding. However, it is undesirable and unsafe to employ welding methods to affix insulating panels to an existing tank which may either contain or be in the vicinity of flammable liquids, gases or solids.

US Patent No. 4,004,394 discloses a method of holding insulating panels to a tank utilizing circumferentially disposed bands adjacent the tank, the panels being held in position by means of clips passing under the straps or bands. Frequently, in the insulation of tanks of substantial size, positioning the circumferential bands and tightening of the bands can be inconvenient and time consuming.

Installation of studs may be difficult on storage well or tanka concrete wall, and these studs may warp or twist and may cause the nails to protrude back through. If wooded studs are used, the studs are prone to mold, moisture damage and rot and require an additional vapor barrier.

Common stud and rolled insulation systems also suffer from difficult installation for wiring, switches, tubing and other components. Conventional construction requires drilling through the studs for routing wiring and/or tubing along the wall.

US20030140588A1 discloses a masonry wall insulation system comprising:

(a) a masonry wall comprised of a plurality of blocks joined together with a settable medium;

(b) a bracket supported by the wall, a part of the bracket held by the settable medium joining two of the courses of blocks;

(c) a sheet of insulating material adjacent to the wall; and

(d) a sheet of wallboard supported adjacent to the sheet of insulating material by the bracket;

wherein

(e) the sheet of insulating material is sandwiched between the wall and the wallboard.

Another conventional approach, disclosed in U.S. Pat. No. 4,191,001, involves reinsulating a concrete block home by (1) applying high-density polystyrene board on the home's exterior walls and (2) applying a polymerically bonded concrete or stucco finish to the polystyrene board. While that technique avoids the need for construction of a second wall, it has its own disadvantages. Masonry walls offer durable and aesthetically appealing exterior surfaces, and the '001 Patent's technique covers those surfaces with another material that may well be less durable and less attractive.

US8539733B2 discloses an insulation panel configured to be fitted between joining profiles in a framework of an insulating building system, wherein said insulation panel is a mineral fiber wool panel, said insulation panel comprising: substantially parallel first and second main surfaces having substantially parallel, oppositely situated, first and second profile contact sides and substantially parallel, oppositely situated, third and fourth sides between said main surfaces, wherein said first and second profile contact sides are provided with a groove substantially parallel to the first main surface in a predetermined distance therefrom whereby said first and second profile contact sides are divided into a profile abutment portion and a profile covering portion; wherein the profile covering portion of the side of the insulation panel comprises a flex zone in at least the profile covering portion extending beyond the profile abutment portion whereby said profile covering portion is made softer and more flexible than the remainder of the panel by reducing fiber bonding in the flex zone, so as to provide a tight panel-to-panel fit and improved thermal insulation when it is joined to another panel.

It can be seen then that a new and improved insulation system is needed. Such a system should provide simple, lightweight, inexpensive and easy to install construction. The present invention addresses these problems, as well as others associated with insulation systems.

SUMMARY OF THE INVENTION

The present invention is directed to a tank insulation system, deploying manufactured of prefabricated mineral insulation panels in accordance with the present invention to provide long-term, maintenance-free thermal control of large bulk storage tanks.

In accordance with the present invention, the insulation panel system is lightweight panel design which leads to faster and easier installations onto the surface of a storage tank or the like with less manpower compared to traditional insulation installation. The greatly reduction of manpower in installation means less exposure time to possible hazard.

The insulation panel system is easy to be protected in the course of bad weather while installing or removing the insulation panel, during construction time or at the maintenance period. The present insulation panel system can be employed to replace or to change conventional insulation to the present on contact insulation panel system with less modification. The insulation panel system can be repaired on-site without affecting system integrity of the insulation of the storage tank. The insulation panel system of the present invention is also weatherproof system.

According to the present invention, the prefabricated insulation panels ensure the utmost quality control standards, and are custom engineered to meet the specific tank height, thickness requirements, and specifications to meet the customers standards for tank insulation.

An object of the present invention is to provide a non-contact insulation system which enables user to pre-fabricate the panel off-site and installation the same to a storage tank, and the non-contact insulation panel system prevents direct contact between the insulation layer and the surface of the tank or the like, and thus corrosion under insulation is avoided.

A main object of the present invention is to provide a non-contact insulation panel for cylindrical tank or the like having a tank shell with a base plate at the bottom thereof comprising

(i) a corrugated panel made from metallic material such as aluminium with prefabricated groove thereon;

(ii) a plurality of vertical pins, spaced apart mounted onto the corrugated panel, wherein the pin is provided with a perforated base and a sharp tip;

(iii) a layer of insulation material mounted onto the corrugated panel, wherein the sharp tip of the vertical pin passes through the insulation material and holds the insulation material in place, and wherein a self locking washer is used to lock onto the sharp tip which is then mounted with an insulation CUI spacer, the sharp tip is then bent sideway to secure the spacer,
thereby a non-contact insulation panel for cylindrical tank is used to fix onto the surface of a cylindrical tank or the like.

Another object of the present invention is to provide a non-contact insulation system which is the optimal constructive solution for the realization of non-contact insulations, and provides precise intertwine system of gap constructions and insulation, ideally fulfils the technical requirements for insulations and corrosion-protection for the avoidance of corrosion under insulation (CUI).

Another main object of the present invention is to provide a method of fabrication non-contact insulation panel system for storage tank comprising the steps of

(i) preparing a corrugated aluminium panel (70), wherein one edge of the panel (70) is a Z-shaped member;
(ii) marking a plurality of locations for the mounting of a plurality of perforated base pins () on the aluminium panel (70);
(iii) securing the perforated base pins (42) on the marked locations by employing a glue or additive, the glue or additive being applied onto the perforated base (44) of the base pins (42);
(iv) installing at least a layer of insulation material (66) on the corrugated panel (70), wherein the insulation material (66) passes through the sharp tip (43) of the perforated base pins (42) and the insulation material (66) is securedly positioned thereon;
(v) installing a washer (73) onto the perforated pins (42) and then followed with an insulation spacer (40); and
(vi) bending the sharp tips (43) of the perforated pins (42) so as to secure the insulation spacers (40) on the corrugated panel (70).

Other and further objects, features and advantages will be apparent in the following description of the method of the present invention, given for the purpose of disclosure, and taken in conjunction with the accompanying drawings where like character references designate like parts throughout the several views.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the drawings, wherein like reference numerals and letters indicate corresponding structure throughout the several views:

FIG. 1 is a perspective view of cylindrical tank mounted with non-contact insulation panel system in accordance with the present invention;

FIG. 2A is a sectional view of the non-contact insulation panel in accordance with the present invention.

FIG. 2B is a sectional side view of one side of the non-contact insulation panel in accordance with the present invention.

FIG. 3A is a perspective view of a CUI spacer in accordance with the present invention, wherein the spacer is made from Polyphenylene Sulfide Black (PPS).

FIG. 3B is a perspective view of another CUI spacer in accordance with the present invention, wherein the spacer is made from silicone material with excellent UV resistance.

FIG. 4 is a perspective view of the non-contact insulation panel in accordance with the present invention, wherein the corrugated aluminium panel is being mounted with a plurality of aluminium pins which secure the PYROGEL and the mineral ROCKWOOL together.

FIG. 5 is a perspective view of an aluminium pin with a perforated base in accordance with the present invention.

FIG. 6 is a perspective view of a locking washer to self-lock with the aluminium pin in accordance with the present invention.

FIG. 7 is a top view indication the non-contact panels that being mounted onto the surface of the tank in accordance with the present invention.

FIG. 8 and FIG. 9 are schematically views showing the installation of insulation panel system (100) onto the tank shell in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and in particular to FIG. 1, which is a perspective view of cylindrical storage tank mounted with non-contact insulation panel system in accordance with the present invention.

In the figure, there is shown a cylindrical tank (90) mounted with a plurality of non-contact insulation panel systems, generally designated 100. The non-contact insulation panel system (100) is for cylindrical shape storage tank (90) or the like, wherein the storage tank (90) is commonly provided with a tank foundation (50) as a base. In general, the cylindrical tank (90) is provided with a stiffening ring (91) around the out surface of the tank (90), and the entire surface of the tank (90) is mounted with a plurality of studs (92), space out equally on the surface of the tank (90) for the securing of the non-contact insulation panel system (100).

The cylindrical tank (90) is provided for the storage of liquid or the like which needs to be thermally insulated to maintain the temperature of the storage liquid in a certain temperature range. The circumferential edge of the tank (90) is provided with a ring of flat bar (98) to ensure closely secured of the non-contact insulation panel system (100). The stiffening ring (91) is located at the surface of the tank (90) at a position close proximity to the central of the tank surface.

FIG. 2A is a sectional view of the non-contact insulation panel in accordance with the present invention, and FIG. 2B is a sectional view showing insulation panel system to be secured together to each other by employing self tapping screw in accordance with the present invention.

As shown in FIG. 2A, the insulation panel system (100) comprises a corrugated panel (70) made from metallic material such as aluminium with prefabricated groove (71) thereon; a plurality of perforated pins (42) (only one pin is being shown), spaced apart and mounted substantially perpendicular onto the corrugated panel (70), wherein the pin (42) is provided with a perforated base (44) at the bottom thereof and a sharp tip (43), and the perforated base (44) is glued onto the corrugated panel (70); at least a layer of insulation material (66) being mounted onto the corrugated panel (70), wherein the sharp tip (43) of the perforated pin (42) passes through the insulation material (66) and holds the insulation material (66) in place, and wherein a self-locking washer (73) is disposed to the sharp tip (43) and is used to lock or secure the insulation material (66) to the corrugated panel (70), and wherein an insulation spacer (40) is finally mounted to the sharp tip (43) which is then bent sideway to secure the spacer (40) , thereby the insulation spacer (40) forms a gap (46) between the corrugated panel (70) and the tank shell (30) when the insulation panel system (100) covers the tank shell (30) or the like.

As shown in the figure, one edge of the corrugated panel (70) is a L-shaped aluminium cladding (72) which is to be mounted onto CD stud (92) being secured on the surface of the tank shell (30). In other words, a plurality of CD studs (92) are mounted on the tank shell (30) prior to the insulation panel system (100) is fixed thereon. An individual insulation panel system (100) is secured onto the tank shell (30) by CD stud (92) which is then secured with a flat washer (74), a spring washer (75) and a nut (76).

FIG. 2B is a sectional view showing insulation panel system to be secured together to each other by employing self tapping screw in accordance with the present invention. In the figure, a plurality of self tapping screws (93) are used to lock an insulation panel system (100) with another insulation panel system (100).

FIG. 2C is a sectional side view of one side of the non-contact insulation panel mounted onto the tank shell in accordance with the present invention. As shown, in the preferred embodiment of the present invention, the insulation gap (46) is formed between the tank shell (30) and the insulation panel system (100), wherein the gap (46) is being formed by the plurality of non-contact insulation CUI (corrosion under insulation) spacers (40). The plurality of self tapping screw (93) are used to enhance the securing the layer of aluminium corrugate panel (70).

In a preferred embodiment of the present invention, there is provided a method of fabrication non-contact insulation panel system for storage tank comprising the steps of

(i) preparing a corrugated aluminium panel (70), wherein one edge of the panel (70) is a L-shaped aluminium cladding member for securing the panel (70) onto the storage tank;

(ii) marking a plurality of locations on the aluminium panel (70) for the mounting of a plurality of perforated base pins (42) having a perforated base (44) and a sharp tip (43) on the aluminium panel (70);

(iii) securing the perforated base pins (42) on the marked locations by employing a glue or additive, the glue or additive being applied onto the perforated base (44) of the perforated base pins (42);

(iv) installing at least a layer of insulation material (66) on the corrugated panel (70), wherein the insulation material (66) passes through the sharp tip (43) of the perforated base pins (42) and the insulation material (66) is securedly positioned thereon;

(v) installing a washer (73) onto the perforated pins (42) and then followed with an insulation spacer (40); and

(vi) bending the sharp tips (43) of the perforated pins (42) so as to secure the insulation spacers (40) on the corrugated panel (70).

FIG. 3A and FIG. 3B show perspective view of two types of CUI spacer (40) which can be employed in the preferred embodiment to create an insulation gap (46) between the tank shell (30) and the insulation panel system (100) of inn accordance with the present invention. FIG. 3A is a perspective view of a CUI spacer (40) in accordance with the present invention, wherein the spacer (40) is made from Polyphenylene Sulfide Black (PPS), and FIG. 3B is a perspective view of another CUI spacer (40) in accordance with the present invention, wherein the spacer (40) is made from silicone material with excellent UV resistance. Both of the spacers (40) can be used in the fabrication of the insulation panel system (100).

In another preferred embodiment, the insulation material (66) that used in the insulation panel system (100) are available from the market. FIG. 4 is a perspective view showing an insulation panel system (100) including a plurality of non-contact insulation CUI spacers (40), a layer of PYROGEL (60), a layer of mineral ROCKWOOD (62) , a plurality of perforated pins (42) with perforated base (44) and stainless steel self locking washer (73), and the aluminium corrugate panel (70) in accordance with the present invention.

FIG. 5 is a perspective view of an aluminium perforated base pin (42) with a perforated base (44) and a sharp tip (43) in accordance with the present invention. As shown in the figure, there is show a perspective view of the aluminium perforated pin (42) with the perforated base (44) to be covered with a glue (tilement glue) or adhesive so that the pin (42) is secured onto the corrugated panel (70) in accordance with the present invention. FIG. 6 is a perspective view of a self locking washer (73) for locking the insulation material (66) when the perforated base pin (42) passes through the insulation material (66). The self locking washer (73) provides strong holding power once the material goes through and the material is secured. The self locking washer (73) works together with the perforated base pin (42) as to provide secured holding of the insulation material (66) to the corrugated panel (70).

In the preferred embodiment, the self locking washer (73) is made from stainless steel.

FIG. 7 is another sectional view of the non-contact insulation panel of the preferred embodiment of the present invention. FIG. 8 and FIG. 9 show the installation of insulation panel system (100) onto the tank shell in accordance with the present invention. In accordance with the present invention, the steps of assembling of the insulation panel (100) onto a cylindrical tank are as follows:

1. Installing a first insulation panel system (100) from the bottom of the tank shell (30) onto the plurality of stud, following with a Z sheet member (80), as shown in FIG. 8;
2. Installing a second insulation panel system (100) on the top of the first insulation panel system (100), and continuing the third insulation panel system (100) until the top of the tank, as shown in FIG. 8;
3. Installing insulation panel system (100) on the adjacent of the first insulation panel system (100) following with a Z sheet member (80) and continuing the installation until the top of the tank shell, as shown in FIG. 9.

It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. A non-contact insulation panel system for cylindrical tank or the like having a tank shell (30) with a base plate (52) at the bottom thereof, the panel system comprising:

a corrugated panel (70) made from metallic material such as aluminium with prefabricated groove (71) thereon;

a plurality of vertical pins (42), spaced apart mounted substantially perpendicular onto the corrugated panel (70), wherein the pin (42) is provided with a perforated base (44) and a sharp tip (43) and the perforated base (44) is glued onto the corrugated panel (70);

layer of insulation material (60) mounted onto the corrugated panel (70), wherein the sharp tip (43) of the vertical pin (42) passes through the insulation material (66) and holds the insulation material (60) in place, and wherein a self-locking washer (73) is disposed to the sharp tip (43) and is used to lock or secure the insulation material (66) to the corrugated panel (70), and wherein an insulation spacer (40) is finally mounted to the sharp tip (43) which is then bent sideway to secure the spacer (40) , thereby the insulation spacer (40) forms a gap between the corrugated panel (70) and the tank shell (30) when the insulation panel system is covered onto the tank shell (30) or the like.

2. A method of fabrication non-contact insulation panel system for cylindrical tank comprising the steps of

(i) preparing a corrugated panel (70), wherein one edge of the panel (70) is a Z-shaped member (80);

(ii) mounting perpendicularly a plurality of pins (42) onto the aluminium panel (70), wherein the pin (42) is provided with a sharp tip (43) and a perforated base (44) to be secured onto the aluminium panel (70);

(III)placing a layer of insulation material (66) onto the aluminium panel (70) wherein the plurality of pins (42) pass through the insulation material (66) and is secured onto the aluminium panel (70);

(iv) Mounting a self locking washer (73) onto the tip (43) of the pin (42) and following with an insulation spacer (40) on to the tip (43);

(v) Bending the tip of the pin (42) to secure the spacer (40) to the panel (70).

3. The non-contact insulation panel system according to claim 1, wherein a tilement glue is used to mount the aluminium pin (42) onto the aluminium panel (70) by proving a layer of tilement glue onto the perforated base (44) of the pin (42) and then secure the perforated base (44) onto the aluminium panel (70).

4. The non contact insulation panel system according to claim 1, wherein the insulation material (60) for the panel (70) is either a single layer of PYROGEL, or a single layer of mineral ROCKWOOL, or the combination thereof.

5. The non contact insulation panel according to claim 1, wherein a plurality of CD studs (92) are mounted on the tank shell to secure with the non contact insulation panel system (100) thereon.

6. The non-contact insulation panel according to claim 4, wherein when the insulation material is a combination of a layer of PYROGEL (60) and a layer of mineral ROCKWOOL (62), the two layers are closely aligned with each other and both the layers are secured by the aluminium pin (42).

7. The non-contact insulation panel according to claim 1, wherein the plurality of spacers (40) are positioned and spaced apart based on the position of the perforated base pins (42) on the aluminium corrugated panel (70) so as to provide a gap when the insulation panel system (100) are mounted onto the tank shell.

8. The non-contact insulation panel according to claim 1, wherein a plurality of self-tapping screw (73) are employed to secure the aluminium corrugated panel (70) with another aluminium corrugated panel (70) next to each other horizontally or/or vertically.

10. The non-contact insulation panel according to claim 1, wherein a bracket (65) and a supporting ring (66) are employed to secure the aluminium corrugated panel (70) to the base plate (52) of the tank shell (30).

11. A non-contact insulation panel system, comprising:

a plurality of rectangular panels or the like having a layer of PYROGEL (60) with a first surface and a second surface, wherein the first surface is mounted with a plurality of insulation CUI spacers (40) for mounting onto the tank shell (30), and a layer of mineral ROCKWOOL (62) mounted onto the second surface of the PYROGEL (60);

a plurality of aluminium pins (42) having one end being a perforated base or washer (44) and another end being secured onto the insulation CUI spacers (40); and

a corrugate panel (70) disposed next to the mineral rock wool (62), which is then secured by a Z-sheet member (80) such that the corrugate panel (70) is in combination with the mineral rock wool (62), whereby the insulation CUI spacer (40) forms a gap between the tank shell (30) and the PYROGEL (60);

a plurality of connecting portions having a roof top edge flat bar (98) along roof edges (99) of the tank, whereby the non-contact insulation panels cover the surface of the tank.