

DESCRIPTION

STORAGE COMPOSITE, AND STORAGE TANK AND PERMEABLE STORAGE TANK USING SAME

5

TECHNICAL FIELD

[0001]

The present invention relates to a storage composite that fills the inside of a storage tank that stores rainwater and others or a permeable storage tank that temporarily stores rainwater and others, and to a storage tank and a permeable storage tank using this storage composite.

15 BACKGROUND ART

[0002]

There has been conventionally disclosed a permeable storage facility for rainwater and others in which a tabular member formed of flat plates and cylindrical portions opened in the flat plate is arranged below ground to form a rainwater storage space and each reinforcing material that extends in a horizontal direction is arranged between the flat plates of the tabular member which are adjacent to each other (see, e.g., Patent Reference 1). In this permeable storage facility, the cylindrical portions of the plurality of tabular members are stacked so as to abut on each other,

and the vertical reinforcing materials are pierced in these cylindrical portions. Materials used for the reinforcing material extending in the horizontal direction and the reinforcing material extending in the vertical direction may be a metal such as stainless steel, concrete, or FRP (Fiber Reinforced Plastics) made of a resin and fibers. Further, shapes of the reinforcing material extending in the horizontal direction and the reinforcing material extending in the vertical direction may be a U-like shape, a prismatic shape, or an L-like shape.

[0003]

To form the storage space of the thus configured permeable storage facility, first, the tabular member on a first level is arranged together with the reinforcing material extending in the horizontal direction, and the reinforcing material extending in the vertical direction is inserted into and erected in the cylindrical portion of the tabular member. Then, the tabular member on a second level is arranged in such a manner that its cylindrical portion abuts on the cylindrical portion of the tabular member on the first level, and the reinforcing material extending in the horizontal direction is fitted into a groove provided in the flat plate of the tabular member on the second level. Subsequently, the tabular member on a third level is laminated so as to be matched with the reinforcing

material extending in the horizontal direction.

Moreover, the tabular members and the reinforcing materials extending in the horizontal direction are sequentially overlapped, and an upper end of the

5 reinforcing material extending in the vertical direction and the reinforcing material extending in the horizontal direction on the highest level are fixed.

[0004]

In the thus configured permeable storage facility,
10 the reinforcing material extending in the vertical direction is inserted so as to penetrate through the cylindrical portion forming the tabular member, and the reinforcing material extending in the horizontal direction is inserted between the flat plates forming
15 the tabular member, thereby reinforcing the permeable storage facility.

CITATION LIST

PATENT LITERATURES

20 [0005]

Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2008-255767 (claim 2, claim 3, paragraph [0006], paragraph [0007], paragraph [0012], paragraph [0014], FIG. 4, FIG. 8)

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DISCLOSURE OF INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0006]

However, in the permeable storage facility disclosed in the conventional Patent Literature 1, since each flat plate and each cylindrical portion
5 constituting the tabular member are integrally formed, the tabular member has a relatively complicated shape, and the number of steps for manufacturing molds for forming the tabular member is inconveniently increased. Additionally, in the permeable storage facility
10 disclosed in the conventional Patent Literature 1, since a cross-sectional area of the cylindrical portion is relatively smaller than a surface area of the flat plate of the tabular member, when an operator mounts the flat plate at a position where the horizontal reinforcing
15 material is not used at the time of assembling the permeable storage facility, the flat plate may possibly deform or strain, and operating efficiency may be possibly lowered. Further, since the permeable storage facility disclosed in the conventional Patent Literature
20 1 adopts the configuration that a displacement of the flat plates of the tabular members adjacent to each other is prevented by the reinforcing material extending in the horizontal direction, when an operator mounts the flat plate of the tabular member and tries to work
25 before providing the reinforcing material extending in the horizontal direction, there occurs a problem that the flat plate of the tabular member deforms, an

operation becomes unstable, and operability is lowered,
or the flat plate of the tabular member is damaged.

Furthermore, in the permeable storage facility disclosed
in the conventional Patent Literature 1, since the

5 laminated tabular members all have the same shape along
the vertical direction, even if desired strength is
obtained by the lower tabular member, excessive strength
is assured in the upper tabular member, there arises a
problem that the configuration becomes wasteful.

10 Furthermore, in the permeable storage facility disclosed
in the conventional Patent Literature 1, since each
tabular member, each reinforcing material extending in
the horizontal direction, and the reinforcing material
extending in the vertical direction constituting this
15 permeable storage facility are all exclusive goods,
there is a drawback that a material cost increases, and
there is a problem that wastes (e.g., a waste pipe) such
as a vinyl chloride pipe that cannot be easily discarded
cannot be used.

20 [0007]

It is a first object of the present invention to
provide a storage composite, and a storage tank and a
permeable storage tank using this which enable reducing
the number of steps for manufacturing molds for forming
25 members such as partitions, end spacers, connecting
spacers, and others having relatively simple shapes by
using these members and also enable using material

without waste. It is a second object of the present invention to provide a storage composite, and a storage tank and a permeable storage tank using this which can improve operating efficiency when each partition is

5 stably supported by each end spacer even though an operator mounts a horizontal connected unit at the time of assembling. It is a third object of the present invention to provide a storage composite, and a storage tank and a permeable storage tank using this which can

10 prevent partitions adjacent to each other from being displaced in the vertical direction even though an operator mounts a horizontal connected unit at the time of assembling since the partitions adjacent to each other are engaged through a convex portion and a concave

15 portion and can also prevent assembling operability from being spoiled since directivity of the partitions does not have to be considered at the time of connection. It is a fourth object of the present invention to provide a storage composite, and a storage tank and a permeable

20 storage tank using this which can decrease strength of an upper side and exclude structural wastes by increasing each vertical interval between horizontal connected plates of multiple levels on the upper side than a lower side. It is a fifth object of the present

25 invention to provide a storage composite, and a storage tank and a permeable storage tank using this which use waste pipes as spacers so that the waste pipes having

difficulty in disposal can be effectively used.

MEANS FOR SOLVING PROBLEM

[0008]

5 According to a first aspect of the present invention, as shown in FIG. 1 to FIG. 3, FIG. 6, FIG. 8, and FIG. 10, there is provided a storage composite 11 which fills the inside of a storage tank or a permeable storage tank, comprising: a plurality of partitions 12
10 having a square plate shape, each of which has at least one cylindrical rib 24 protruded on a lower surface thereof and at least one cylindrical rib 28 protruded on an upper surface thereof; a plurality of funnel-shaped end spacers 13, each of which has a large-diameter
15 cylindrical portion 13a that is connected to one or both of the lower surface and the upper surface of the partition 12 while being fitted on the cylindrical rib 24, 28, and a small-diameter cylindrical portion 13b which is integrally formed with the large-diameter
20 cylindrical portion 13a and formed with a diameter smaller than the large-diameter cylindrical portion 13a; and a plurality of cylindrical connecting spacers 14, each of which has both ends fitted in the small-diameter cylindrical portions 13b, 13b of a pair of end spacers
25 13, 13 facing each other and extends in a vertical direction, wherein a diameter T of a portion of the cylindrical rib 24, 28 fitted into the large-diameter

cylindrical portion 13a is set to fall within the range of 0.40S to 0.95S where S is a length of one side of the partition 12, horizontal connected units 33, each of which is configured by aligning the plurality of
5 partitions 12 on the same horizontal planes and coupling them, are provided on a plurality of levels, and the end spacers 13 and the connecting spacers 14 are interposed between the horizontal connected units 33 on the plurality of levels.

10 [0009]

Further, according to a second aspect of the present invention, as shown in FIG. 1 to FIG. 3, FIG. 6, FIG. 8, and FIG. 10, the invention based on the first aspect is characterized in that an insertion hole 12a is
15 formed at the center of each of the plurality of partitions 12, and a spindle pipe 16 is vertically inserted into the insertion hole 12a of each partition 12 constituting each of the horizontal connected units 33 on the plurality of levels.

20 [0010]

Furthermore, according to a third aspect of the present invention, as shown in FIG. 1, FIG. 6, and FIG. 8, the invention based on the first aspect is characterized in that a plurality of bottom plates 37
25 are formed by flatly forming a lower surface of each of the plurality of partitions constituting the horizontal connected unit 36 on the lowest level, and a plurality

of top panels 47 are formed by flatly forming an upper surface of each of the plurality of partition constituting the horizontal connected unit 46 on the highest level.

5 [0011]

Moreover, according to a fourth aspect of the present invention, as shown in FIG. 15, the invention based on the first aspect is characterized in that each vertical interval between the horizontal connected units 33, 36, 46 on the plurality of levels is configured to be larger on an upper side than on a lower side.

[0012]

Additionally, according to a fifth aspect of the present invention, as shown in FIG. 2, FIG. 3, FIG. 10, FIG. 12, and FIG. 13, the invention based on the first aspect is characterized in that a convex portion 12e and a concave portion 12f are provided on each of four side surfaces of the partition 12, the convex portion 12e of the partition 12 engages with the concave portion 12f of a partition 12 adjacent to the partition 12, and the concave portion 12f of the partition 12 engages with the convex portion 12e of a partition 12 adjacent to the partition 12.

[0013]

Further, according to a sixth aspect of the present invention, as shown in FIG. 21 to FIG. 24, the invention based on the fifth aspect is characterized in that the

partition 112 comprises: a partition main body 112b having a square plate shape; and a square tube rib 112c having a square frame shape protruded on each of an upper side and a lower side of the partition main body 112b over an entire outer periphery of the partition main body 112b, the convex portion 113 comprises: a plurality of first convex portions 113a having a rectangular plate shape which are provided on an outer peripheral surface of the square tube rib 112c above the partition main body 112b in a longitudinal direction of the outer peripheral surface of the square tube rib 112c at predetermined intervals; and a plurality of second convex portions 113b having a rectangular plate shape which are provided on the outer peripheral surface of the square tube rib 112c below the partition main body 112b in the longitudinal direction of the outer peripheral surface of the square tube rib 112c at predetermined intervals, the concave portion 114 comprises: a first concave portion 114a provided between the plurality of first convex portions 113a; and a second concave portion 114b provided between the plurality of second convex portions 113b, the first convex portion 113a is placed immediately below the second concave portion 114b, the second convex portion 113b is placed immediately above the first concave portion 114a, and the first and second convex portions 113a, 113b and the first and second concave portions

114a, 114b are thereby arranged on the outer peripheral surface of the square tube rib 112c in a reticular pattern, and the first convex portion 113a of the partition 112 engages with the first or second concave portion 114a, 114b of a partition 112 adjacent to the partition 112, and the second convex portion 113b of the partition 112 engages with the second or first concave portion 114b, 114a of the partition 112 adjacent to the partition 112.

[0014]

According to a seventh aspect of the present invention, as shown in FIG. 16 to FIG. 19, there is provided a storage composite 91 which fills the inside of a storage tank or a permeable storage tank, comprising: a plurality of partitions 12 having a square plate shape, each of which has an insertion hole 12a formed at the center, a plurality of cylindrical ribs 21 to 24 protruded on a lower surface thereof concentrically with the insertion hole 12a, and a plurality of cylindrical ribs 25 to 28 protruded on an upper surface thereof concentrically with the insertion hole 12a; a plurality of frustum cylindrical or cylindrical spacers 93 connected to one or both the lower surface and the upper surface of the partition 12 so as to be movably inserted into any one of a plurality of ring grooves between the plurality of cylindrical ribs 21 to 28; and a spindle pipe 16 inserted into the

insertion hole 12a of each partition 12, wherein
horizontal connected units 33, which are configured by
aligning the plurality of partition 12 on the same
horizontal plane and coupling them, are provided on a
5 plurality of levels, the spacer 93 is interposed between
the horizontal connected units 33 on the plurality of
levels, the spindle pipe 16 is vertically inserted into
the insertion hole 12a of each of the partitions 12
constituting the horizontal connected units 33 on the
10 plurality of levels, a convex portion 12e and a concave
portion 12f are provided on each of four side surfaces
of the partition 12, the convex portion 12e of the
partition 12 engages with the concave portion 12f of a
partition 12 adjacent to the partition 12, and the
15 concave portion 12f of the partition 12 engages with the
convex portion 12e of a partition 12 adjacent to the
partition 12.

[0015]

Furthermore, according to an eighth aspect of the
20 present invention, the invention based on the sixth
aspect is characterized in that the partition comprises:
a partition main body having a square plate shape, which
has an insertion hole formed at the center; and a square
tube rib having a square frame shape protruded on each
25 of an upper side and a lower side of the partition main
body over an entire outer periphery of the partition main
body, the convex portion comprises: a plurality of first

convex portions having a rectangular plate shape which are provided on an outer peripheral surface of the square tube rib above the partition main body in a longitudinal direction of the outer peripheral surface of the square tube rib at predetermined intervals; and a plurality of second convex portions having a rectangular plate shape which are provided on the outer peripheral surface of the square tube rib below the partition main body in the longitudinal direction of the outer peripheral surface of the square tube rib at predetermined intervals, the concave portion comprises: a first concave portion provided between the plurality of first convex portions; and a second concave portion provided between the plurality of second convex portions, the first convex portion is placed immediately below the second concave portion, the second convex portion is placed immediately above the first concave portion, and the first and second convex portions and the first and second concave portions are thereby arranged on the outer peripheral surface of the square tube rib in a reticular pattern, and the first convex portion of the partition engages with the first or second concave portion of a partition adjacent to the partition, and the second convex portion of the partition engages with the second or first concave portion of the partition adjacent to the partition.

[0016]

According to a ninth aspect of the present invention, as shown in FIG. 3, FIG. 6, FIG. 8, and FIG. 14, there is provided a storage tank, wherein the storage tank is filled with the storage composite 11 according to any one of the first to sixth aspects, and foam plates 57 abut on the outermost surfaces of a plurality of end spacers 13 placed on the outermost side of a plurality of end spacers 13 in the filling storage composite 11, and the foam plates 57 thereby surround the end spacers 13 and the connecting spacers 14 between the horizontal connected units 33 on the plurality of stages.

[0017]

According to a 10th aspect of the present invention, as shown in FIG. 18 to FIG. 20, there is provided a storage tank, wherein the storage tank is filled with the storage composite 91 according to the seventh or eighth aspect, and foam plates 57 abut on the outermost surfaces of a plurality of spacers 93 placed on the outermost side of a plurality of spacers 93 in the filling storage composite 91, and the foam plates 57 thereby surround the plurality of spacers 93 between the horizontal connected units 33 on the plurality of stages.

[0018]

According to an 11th aspect of the present invention, there is provided a permeable storage tank, wherein the permeable storage tank is filled with the

storage composite according to any one of the first to sixth aspects, and foam plates abut on the outermost surfaces of a plurality of end spacers placed on the outermost side of a plurality of end spacers in the filling storage composite, and the foam plates thereby surround the end spacers and the connecting spacers between the horizontal connected units on the plurality of stages.

[0019]

10 According to a 12th aspect of the present invention, there is provided a permeable storage tank, wherein the permeable storage tank is filled with the storage composite according to the seventh or eighth aspect, and foam plates abut on the outermost surfaces of a plurality of spacers placed on the outermost side of a plurality of spacers in the filling storage composite, and the foam plates thereby surround the plurality of spacers between the horizontal connected units on the plurality of stages.

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EFFECT OF THE INVENTION

[0020]

In the storage composite according to the first aspect of the present invention, assuming that S is a length of one side of a partition, the diameter T of the cylindrical rib of the partition at the position where it fits to the large-diameter portion of the end spacer

is set to fall within the range of $0.40S$ to $0.95S$, the horizontal connected units each of which is configured by aligning and connecting the plurality of partitions with each within the same horizontal plane are provided
5 on the plurality of levels, the end spacers and the connecting spacers are interposed between the horizontal connected units of the plurality of levels, and hence a partial pressure in the vertical direction in external force that acts on the storage composite is received by
10 the end spacers and the connecting spacers whilst a partial pressure in the horizontal direction in the external force that acts on the storage composite is mainly received by the horizontal connected units. As a result, even the storage composite formed by assembling
15 the members having relatively simple shapes can assure strength of a relatively large structure. Further, as compared with a conventional permeable storage facility in which a tabular member has a relatively complicated shape since a flat plate and a cylindrical portion
20 constituting the tabular member are integrally formed and the number of steps for manufacturing molds that are used for molding the tabular member increases, in the present invention, since the partitions, the end spacers, and the connecting spacers having the relatively simple
25 shapes are used, and hence the number of steps for manufacturing the molds which are used for molding these members can be reduced. Furthermore, as compared with

the conventional permeable storage facility in which a cross-sectional area of the cylindrical portion is relatively smaller than a surface area of a flat plate of the tabular member and hence the flat plate deforms or strains to lower operating efficiency when an operator mounts a portion where a horizontal reinforcing material is not used in the flat plate at the time of assembling the permeable storage facility, in the present invention, since each partition is stably supported by each end spacer even if the operator mounts each horizontal connected unit at the time of assembling the storage composite, the operating efficiency can be improved, and using the connecting spacer having the smaller diameter than the large-diameter tube portion of each of the upper and lower end spacers enables reducing the number of starting materials for manufacturing the spacers.

[0021]

In the storage composite according to the second aspect of the present invention, since each insertion hole is formed in the center of each of the plurality of partitions and the spindle pipe is vertically inserted into the insertion hole of each partition constituting each of the horizontal connected units on the plurality of levels, the spindle pipes, the partitions, the end spacers, and the connecting spacers receive a partial pressure in the vertical direction in external force

acting on the storage composite, and the horizontal
connected units on the upper and lower levels coupled
and integrated through the spindle pipes receive a
partial pressure in the horizontal direction in the
5 external force acting on the storage composite. As a
result, even if the storage composite formed by
assembling the members having the relatively simple
shapes is assembled so as to be larger than the storage
composite according to the first aspect, especially
10 assembled so as to be higher than a height of the
storage composite according to the first aspect,
strength as the structure can be assured.

[0022]

In the storage composite according to the third
15 aspect of the present invention, since the plurality of
bottom plates are formed by forming flat lower surfaces
of the plurality of partitions constituting the
horizontal connected unit on the lowermost level and the
plurality of top panels are formed by forming the flat
20 upper surfaces of the plurality of partitions
constituting the horizontal connected unit on the
uppermost level, there is no cylindrical rib protruding
on the lower surfaces of the bottom plates or no
cylindrical rib protruding on the upper surfaces of the
25 top panel in case of wrapping the storage composite with
an impermeable sheet or a permeable sheet, and the
impermeable sheet or the permeable sheet can be

prevented from being damaged by edges of these ribs.

Further, when the bottom plates and the top panels are molded into the same shape, the number of steps for manufacturing molds can be reduced, and the number of

5 components can be decreased, thus facilitating component management.

[0023]

In the storage composite according to the fourth aspect of the present invention, since each interval

10 between the horizontal connected units on the plurality of levels in the vertical direction is configured to be larger on the upper side than the lower side, strength on the upper side can be lowered, and structural wastes can be excluded.

15 [0024]

In the storage composite according to the fifth aspect of the present invention, the convex portion and the concave portion are provided on each of the four side surfaces of the partition, the convex portion of

20 the partition engages with the concave portion of the partition adjacent to this partition, and the concave portion of the partition engages with the convex portion of the partition adjacent to this partition, whereby the partitions adjacent to each other can be prevented from
25 being displaced in the vertical direction, thus further firmly connecting the partitions adjacent to each other. As a result, the horizontal connected units which are

coupled with each other by aligning the plurality of partitions on the same horizontal plane can be structurally further strengthened. Further, as compared with the conventional permeable storage facility in which the flat plate of the tabular member falls to be deformed or damaged when an operator mounts the flat plate of the tabular member before setting the horizontally extending reinforcing material and tries to work at the time of assembling the permeable storage facility, in the present invention, each partition is stably supported by each end spacer and the partitions adjacent to each other are engaged through the convex portion and the concave portion even if an operator mounts the horizontal connected units at the time of assembling the storage composite, and hence the partitions adjacent to each other can be prevented from being displaced in the vertical direction. Moreover, since directivity of these partitions does not have to be considered at the time of coupling the respective partitions, and hence assembling operability of the storage composite is not spoiled.

[0025]

In the storage composite according to the sixth or eighth aspect of the present invention, since the first and second convex portions and the first and second concave portions are arranged on the outer peripheral surface of the square tube rib in a reticular pattern by

placing the first convex portion immediately below the second concave portion and placing the second convex portion immediately above the first concave portion, even if each partition is turned over or any one of the
5 four outer peripheral surface of each partition is appressed against a partition adjacent to this partition, the first convex portion of the partition engages with the first or second concave portion of a partition adjacent to this partition, and the second convex
10 portion of the partition engages with the second or first concave portion of a partition adjacent to this partition. As a result, each partition can be relatively easily laid out. Since it is possible to assuredly avoid the horizontal displacement of the
15 adjacent partition in addition to the vertical displacement of the adjacent partition, the partitions which are adjacent to each other can be further firmly coupled. Further, since the end surfaces of the first and second convex portions protruding on the outer
20 peripheral surfaces of the horizontal connected units coupled by aligning the plurality of partitions on the same horizontal plane are flat surfaces each having a relatively large surface, a member (e.g., a foam plate) inserted along the outer peripheral surface of each
25 horizontal connected unit or a member (e.g., the impermeable sheet or the permeable sheet) facing the outer peripheral surface of each horizontal connected

unit is not damaged.

[0026]

In the storage composite according to the seventh aspect of the present invention, the horizontal
5 connected units, which are configured by aligning and coupling the plurality of partitions on the same horizontal plate, are provided on the plurality of levels, the spacers are interposed between the horizontal connected units on the plurality of levels,
10 and the spindle pipe is inserted into the insertion hole in each partition constituting each of the horizontal connected units on the plurality of levels along the vertical direction, whereby the spindle pipes and the spacers receive a partial pressure along the vertical
15 direction in external force acting on the storage composite whilst the horizontal connected units on the upper and lower levels coupled and integrated through the spindle pipes receive a partial pressure in the horizontal direction in the external force acting on the
20 storage composite. As a result, even the storage composite formed by assembling the members each having a relatively simple shape can assure strength of a relatively large structure. Furthermore, as compared with the conventional permeable storage facility in
25 which each flat plate and each cylindrical portion constituting the tabular member are integrally formed, the tabular member has a relatively complicated shape,

and hence the number of steps for manufacturing molds required for molding the tabular member increases, in the present invention, since the partitions and the spacers having the relatively simple shapes are used, 5 the number of steps for manufacturing molds used for molding these members can be reduced. Additionally, the plurality of cylindrical ribs are protruded on the lower surfaces of the partitions concentrically with the insertion holes, the plurality of cylindrical ribs are 10 protruded on the upper surfaces of the partitions concentrically with the insertion holes, and the spacers are connected to one or both of the upper surface and the lower surface of each partition so as to be movably inserted into any one of the plurality of ring grooves 15 between the plurality of cylindrical ribs, waste pipes having different diameters can be used as the spacers as long as they are spacers that can be selectively movably inserted into any one of the plurality of ring grooves. As a result, the waste pipes having difficulty in 20 disposal can be effectively used. Moreover, since the convex portion and the concave portion are provided on the four side surfaces of each partition in such a manner that the convex portion of the partition engages with the concave portion of the partition adjacent to 25 this partition and the concave portion of the partition engages with the convex portion of the partition adjacent to each partition, the partitions adjacent to

each other can be prevented from being displaced in the vertical direction, and the partitions adjacent to each other can be further firmly coupled. As a result, the horizontal connected units coupled with each other by
5 aligning the plurality of partitions on the same horizontal plane can be structurally further reinforced. Additionally, as compared with the conventional permeable storage facility in which each flat plate of the tabular member falls to be deformed or damaged when
10 an operator mounts the flat plate of the tabular member before setting the reinforcing material extending in the horizontal direction and tries to work at the time of assembling the permeable storage facility, in the present invention, since the partitions adjacent to each
15 other engage with each other though the convex portion and the concave portion even if the operator mounts the horizontal connected units at the time of assembling the storage composite, the vertical displacement of the partitions adjacent to each other can be avoided.
20 Further, since directivity of the respective partitions does not have to be considered at the time of coupling them, assembling operability of the storage composite is not spoiled.

[0027]

25 Since the storage tank according to the ninth aspect of the present invention or the permeable storage tank according to the 11th aspect of the present

invention is filled with the storage composite and the foam plates abut on the outermost surfaces of the plurality of end spacers placed on the outermost side in the plurality of end spacers of the storage composite filling such a tank so that the foam plates can surround the end spacers and the connecting spacers between the horizontal connected units on the plurality of levels, in case of wrapping the storage composite together with the foam plates with the impermeable sheet, even if a partial pressure in the horizontal direction in an external pressure acting on the storage composite acts on the impermeable sheet in a pressure-welding direction, the flat surfaces of the foam plates each having a large area receive this external pressure. As a result, the impermeable sheet can be prevented from being damaged.

[0028]

Since the storage tank according to the 10th aspect of the present invention or the permeable storage tank according to the 12th aspect of the present invention is filled with the storage composite and the foam plates abut on the outermost surfaces of the plurality of end spacers placed on the outermost side in the plurality of end spacers of the storage composite filling such a tank so that the foam plates can surround the spacers between the horizontal connected units on the plurality of levels, in case of wrapping the storage composite together with the foam plates with the impermeable sheet,

even if a partial pressure in the horizontal direction in an external pressure acting on the storage composite acts on the impermeable sheet in a pressure-welding direction, the flat surfaces of the foam plates each
5 having a large area receive this external pressure. As a result, the impermeable sheet can be prevented from being damaged.

BRIEF DESCRIPTION OF DRAWINGS

10 [0029]

FIG. 1 is a cross-sectional view taken along a line A-A in FIG. 2 showing a state that a storage tank according to a first embodiment of the present invention is filled with storage composites;

15 FIG. 2 is a cross-sectional view taken along a line B-B in FIG. 1 showing a state that the storage composites are aligned in a horizontal direction in the storage tank;

FIG. 3 is an enlarged cross-sectional view of a
20 portion C in FIG. 2;

FIG. 4 is a plan view of a first connecting member that connects respective corner portions of four partitions which are adjacent to each other on the same horizontal plane of the storage composite;

25 FIG. 5 is a plane view of a second connecting member that connects respective corner portions of two partitions which are placed on the outermost sides and

adjacent to each other on the same horizontal plane of the storage composite;

FIG. 6 is an enlarged cross-sectional view of a portion D in FIG. 1;

5 FIG. 7 is a longitudinal cross-sectional view showing a state that bottom plates adjacent to each other are connected to each other through the first or second connecting member;

10 FIG. 8 is an enlarged cross-sectional view of a portion E in FIG. 1;

FIG. 9 is a longitudinal cross-sectional view showing a state that top panels adjacent to each other are connected to each other through the first or second connecting member;

15 FIG. 10 is a plan view of the partition;

FIG. 11 is a longitudinal cross-sectional view showing a state that the partitions adjacent to each other are connected to each other through the first or second connecting member;

20 FIG. 12 is a cross-sectional view taken along a line F-F and a cross-sectional view taken along a line G-G in FIG. 10;

FIG. 13 is a cross-sectional view taken along a line H-H and a cross-sectional view taken along a line I-I in FIG. 10;

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FIG. 14 is a side elevation of a primary part in the storage tank showing a state that foam plates abut

on outer side surfaces of each end spacer placed on the outermost side of the storage composite;

FIG. 15 is a cross-sectional view associated with FIG. 1, showing a state that storage tank according to a second embodiment of the present invention is filled with storage composites;

FIG. 16 is a cross-sectional view taken along a line J-J in FIG. 17, showing a state that a storage tank according to a third embodiment of the present invention is filled with storage composites;

FIG. 17 is a cross-sectional view taken along a line K-K in FIG. 16, showing a state that the storage composites are aligned in the horizontal direction in the storage tank;

FIG. 18 is an enlarged cross-sectional view of a portion L in FIG. 16;

FIG. 19 is an enlarged cross-sectional view of a portion M in FIG. 16;

FIG. 20 is a side elevation of a primary part in the storage tank, showing a state that a foam plate abuts on an outer side surface of a spacer placed on the outermost side of the storage composite;

FIG. 21 is a cross-sectional view associated with FIG. 1, showing a state that a storage tank according to a fourth embodiment of the present invention is filled with storage composites;

FIG. 22 is an enlarged cross-sectional view of a

portion N in FIG. 21;

FIG. 23 is an enlarged cross-sectional view of a portion P in FIG. 21; and

FIG. 24 is a perspective view showing a partition
5 of the storage composite from an obliquely upper side.

MODE(S) FOR CARRYING OUT THE INVENTION

[0030]

Modes for carrying out the present invention will
10 now be described with reference to the drawings.

[0031]

<First Embodiment>

As shown in FIG. 1 and FIG. 2, a storage tank which stores rainwater and the like is filled with storage
15 composites 11. The storage composite 11 includes: a plurality of partitions 12 each having at least one cylindrical rib 24 protruding on a lower surface thereof and at least one cylindrical rib 28 protruding on an upper surface thereof; a plurality of funnel-shaped end
20 spacers 13 each having a large-diameter tube portion 13a that is fitted and connected to the cylindrical rib 24 on the lower surface and the cylindrical rib 28 on the upper surface of the partition 12 and a small-diameter tube portion 13b having a smaller diameter than this
25 large-diameter tube portion 13a; and a plurality of cylindrical connecting spacers 14 each of which has both ends fitted to the small-diameter tube portions 13b and

13b of a pair of end spacers 13 and 13 facing each other and extends in a vertical direction.

[0032]

As shown in FIG. 3, FIG. 6, FIG. 8, and FIG. 10 to
5 FIG. 13, the partition 12 has a square-plate-like partition main body 12b having an insertion hole 12a formed at the center, a square-frame-like square tube rib 12c protruding downward over the entire outer periphery of this partition main body 12b, four first to
10 fourth cylindrical ribs 21 to 24 protruding on a lower surface of the partition main body 12b in the same direction (downward) as the protruding direction of the square tube rib 12c concentrically with the insertion hole 12a, and four fifth to eighth cylindrical ribs 25
15 to 28 protruding on the upper surface of the partition main body 12b in the opposite direction (upward) of the protruding direction of the square tube rib 12c concentrically with the insertion hole 12a. The partition main body 12, the square tube rib 12c, and the
20 first to eighth cylindrical ribs 21 to 28 are integrally molded by using plastic such as a polyolefin resin (polypropylene, polyethylene, or the like) or a vinyl chloride resin. Further, at least one cylindrical rib protruding on the lower surface of the partition 12
25 corresponds to the fourth cylindrical rib 24, and at least one cylindrical rib protruding on the upper surface of the partition 12 corresponds to the eighth

cylindrical rib 28.

[0033]

The square tube rib 12c of the partition 12 is formed with a height higher than those of the first to eighth cylindrical ribs 21 to 28 (FIG. 6, FIG. 8, and FIG. 10 to FIG. 13). Further, of the first to eighth cylindrical ribs 21 to 28, each of the first and fifth cylindrical ribs 21 and 25 is a cylindrical rib with a minimum diameter that is protruded on the entire peripheral edge of the insertion hole 12a. The second to fourth cylindrical ribs 22 to 24 are formed in such a manner that their diameters gradually increase from the second cylindrical rib 22 toward the fourth cylindrical rib 24, and the sixth to eighth cylindrical ribs 26 to 28 are formed in such a manner that their diameters gradually increase from the sixth cylindrical rib 26 toward the eighth cylindrical rib 28. Further, the first cylindrical rib 21 and the fifth cylindrical rib 25 have the same diameter, the second cylindrical rib 22 and the sixth cylindrical rib 26 have the same diameter, the third cylindrical rib 23 and the seventh cylindrical rib 27 have the same diameter, and the fourth cylindrical rib 24 and the eighth cylindrical rib 28 have the same diameter. Here, assuming that a length of one side of the partition 12 is S, a diameter T of a portion of each of the fourth and eighth cylindrical ribs 24 and 28 fitted to the large-diameter tube portion

13a of the end spacer 13 is set to fall within the range of 0.40S to 0.95S or preferably 0.75S to 0.90S. The diameter T is restricted to the range of 0.40S to 0.95S because each partition 12 cannot be stably supported by
5 each end spacer 13 when an operator mounts a later-described horizontal connected unit 33 at the time of assembling the storage composite 11 in case of less than 0.40S and each of the fourth and eighth cylindrical ribs 24 and 28 protrudes toward the outside of the partition
10 main body 12b and a gap is produced with respect to the adjacent partition 12 in case of greater than 0.95S. It is to be noted that a plurality of fan-shaped through holes 12d are formed between the respective cylindrical ribs 21 to 28 in the partition main body 12b (FIG. 3,
15 FIG. 6, FIG. 8, and FIG. 10). These through holes 12d are formed so that rainwater or the like stored in a storage tank can circulate around the respective portions and generation of an air pocket in the storage tank can be avoided.

20 [0034]

Convex portions 12e and concave portions 12f are provided on four side surfaces of the partition 12 at predetermined intervals (FIG. 10, FIG. 12, and FIG. 13). Specifically, when each side surface is placed on the
25 upper side in a planar view of the partition 12, the convex portion 12e is provided on the left side of the side surface placed on the upper side, and the concave

portion 12f is provided on the right side of the same (FIG. 10). That is, the convex portion 12e and the concave portion 12f are provided on each of the four side surface of the partition 12 so as to be point-symmetrical with a hole core of the insertion hole 12a at the center. Furthermore, a longitudinal cross-sectional shape of the convex portion 12e in a protruding direction is substantially a right-triangular shape having an inclined surface inclined downward as distanced from the side surface of the partition 12 and a lower surface horizontally extending from the side surface of the partition 12, and a protrusion 12g extending downward along an end edge of the lower surface is provided at this end edge (FIG. 12 and FIG. 13). Moreover, the concave portion 12f has a vertical concave portion 12j formed by notching an upper portion of the square tube rib 12c and a horizontal concave portion 12i formed by notching a side portion of the partition main body 12b so as to be continuous with this vertical concave portion 12h. As a result, the convex portion 12e on one side surface of the partition 12 engages with the concave portion 12f on one side surface of the partition 12 adjacent to the one side surface of this partition 12, and the concave portion 12f on one side surface of the partition 12 engages with the convex portion 12e on one side surface of the partition 12 adjacent to this partition 12. It is to be noted that,

in this embodiment, when each side surface is placed on the upper side in a planar view of the partition, the convex portion is provided on the left side of the side surface placed on the upper side and the concave portion is provided on the right side of the same, but the concave portion may be provided on the left side of the side surface placed on the upper side and the convex portion may be provided on the right side of the same.

[0035]

On the other hand, the large-diameter tube portion 13a and the small-diameter tube portion 13b of the end spacer 13 are connected through a taper tube portion 13c, and a stopper ring 13d is protruded on an inner surface of a connecting portion for the small-diameter tube portion 13b and the taper tube portion 13c (FIG. 6 and FIG. 8). The large-diameter tube portion 13a is fitted when it is inserted into the fourth cylindrical rib 24 or the eighth cylindrical rib 28 of the partition 12. Additionally, a ring-like step portion 13e is formed on an outer surface of a connecting portion for the large-diameter tube portion 13a and the taper tube portion 13c, and four arc-shaped receiving ribs 13f are protruded on an outer peripheral edge of the step portion 13e toward the small-diameter tube portion 13b side at equal intervals, i.e., intervals of 90 degrees (FIG. 3, FIG. 6, and FIG. 8). An outer surface of each of these receiving ribs 13f is protruded slightly outward from

the outer surface of the large-diameter tube portion 13a, and the outer surface of each receiving rib 13f is configured to receive a later-described foam plate 57. The large-diameter tube portion 13a of another end

5 spacer 13 can be movably inserted into the ring-like step portion 13e. As a result, at the time of conveying the plurality of end spacers 13 as components, when the large-diameter tube portion 13a of the end spacer 13 is movably inserted into the ring-like step portion 13e of

10 another end spacer 13 and the plurality of end spacers 13 are stacked, a space occupied by the end spacers 13 during the conveyance is reduced, and conveyance efficiency can be improved. Further, the large-diameter tube portion 13a, the small-diameter tube portion 13b,

15 the taper tube portion 13c, the stopper ring 13d, the step portion 13e, and the receiving rib 13f are integrally molded with use of plastic, e.g., a polyolefin resin (polypropylene, polyethylene, or the like) or a vinyl chloride resin. It is to be noted that

20 reference sign 13g in FIG. 3 denotes an elliptic hole formed in the taper tube portion 13c. This elliptic hole 13g is formed in order to rapidly lead rainwater or the like stored in the storage tank into the end spacer 13 and thereby avoid generation of an air pocket in the

25 end spacer 13. Furthermore, in this embodiment, the four receiving ribs are formed on the outer peripheral edge of the step portion of the end spacer at equal

intervals, but ring-like receiving ribs may be protruded on the entire outer peripheral edge of the step portion of the end spacer.

[0036]

5 The connecting spacer 14 is formed by cutting a commercially available plastic pipe such as a VU pipe (a sewerage hard vinyl chloride pipe on which an inner pressure does not act) to a predetermined length (FIG. 1, FIG. 6, and FIG. 8). This connecting spacer 14 is
10 fitted when inserted into the small-diameter tube portion 13b of the end spacer 13. An end surface of the connecting spacer 14 inserted into the small-diameter tube portion 13b of the end spacer 13 is configured to abut on the stopper ring 13d. Further, each slot 14a
15 extending in the vertical direction is formed in the connecting spacer 14. This slot 14a is formed to avoid generation of an air pocket in the connecting spacer 14 by rapidly introducing rainwater or the like stored in the storage tank into the connecting spacer 14. It is
20 to be noted that, if structural strength is required for the connecting spacer, a plastic pipe such as VP pipe (a waterworks hard vinyl chloride pipe on which an inner pressure acts) can be used in place of the VU pipe. The VP pipe is formed with a larger wall thickness than that
25 of the VU pipe.

[0037]

A spindle pipe 16 is vertically inserted into the

insertion hole 12a of the partition 12. This spindle pipe 16 is made of plastic such as polyvinyl chloride (PVC) or polypropylene (PP). An outer diameter of the spindle pipe 16 is formed to be slightly smaller than a diameter of the insertion hole 12a of the partition 12 (FIG. 3, FIG. 6, and FIG. 8). As a result, the spindle pipe 16 can be smoothly inserted into the insertion hole 12a. Furthermore, a plurality of slots 16a extending in the longitudinal direction of the spindle pipe 16 are formed in an outer peripheral surface of the spindle pipe 16 at predetermined intervals (FIG. 6 and FIG. 8). These slots 16a are formed to prevent generation of an air pocket in the spindle pipe 16 by introducing rainwater or the like stored in the storage tank into the spindle pipe 16. Moreover, a length of the spindle pipe 16 extends from a bottom surface to an upper surface of the storage tank (FIG. 1). When a depth of the storage tank is larger than the length of the spindle pipe 16, a pipe connector (not shown) is used for connection. It is to be noted that, when the storage tank is relatively small and relatively small strength alone is required, the spindle pipe may be omitted.

[0038]

When the plurality of partitions 12 are aligned on the same horizontal plane and coupled with each other through the first or second connecting members 31 or 32,

a horizontal connected unit 33 is configured (FIG. 2 to FIG. 5 and FIG. 11). That is, respective corner portions of the four partitions 12 which are adjacent to each other on the same horizontal surface of the storage composite 11 are coupled with each other through the first connecting members 31, and respective corner portions of the two partitions 12 which are placed on the outermost side on the same horizontal plane of the storage composite 11 and adjacent to each other are coupled with each other through the second coupling members 32, thereby configuring the horizontal connected unit 33. The first connecting member 31 has a first connecting main body 31a formed into a square plate shape and a first engagement protrusion 31b protruded on each of the four corner portions on one surface of the first connecting main body 31a. The first engagement protrusion 31b is constituted of a cylindrical protrusion main body 31c and four engagement ribs 31d provided on the outer peripheral surface of the protrusion main body 31c in the circumferential direction at predetermined intervals (FIG. 4 and FIG. 11). Each of these engagement ribs 31d is formed into a taper shape that a protruding height from the outer peripheral surface of the protrusion main body 31c gradually decreases as getting closer to the distal end from the proximal end of the protrusion main body 31c. Engagement holes 12j facing the first engagement

protrusions 31b are formed at four corner portions of the partition main body 12b of the partition 12, respectively. A diameter of a virtual circle (a circle indicated by a two-dot chain line in FIG. 4) connecting the outer surfaces of each of the four engagement ribs 31d provided at the periphery of the protrusion main body 31c of the first engagement protrusion 31b is formed to be larger than a diameter of the engagement hole 12j on the proximal end side of the first engagement protrusion 31b, and it is formed to be smaller than a diameter of the engagement hole 12j on the distal end side of the first engagement protrusion 31b. As a result, when the distal end portion of the first engagement protrusion 31b smaller than the diameter of the virtual circle is inserted into each engagement hole 12j so that each first engagement protrusion 31b can be put into each engagement hole 12j, the proximal end portion of each first engagement protrusion 31b having the large diameter of the virtual circle engages with each engagement hole 12j in an interference fit state, and each first engagement protrusion 31b cannot be removed from each engagement hole 12j. On the other hand, the second coupling member 32b has a second connecting main body 32a having a rectangular plate shape relatively largely chamfered on two corner portions and two second engagement protrusions 32b protruded on two corner portions on one

surface of the second connecting main body 32a (FIG. 5 and FIG. 11). The second engagement protrusion 32b is constituted of a protrusion main body 32c and an engagement rib 32d and formed into the same shape as the first engagement protrusion 31b. The first and second connecting members 31 and 32 are molded by using plastic such as a polyolefin resin (polypropylene, polyethylene, or the like) or a vinyl chloride resin. It is to be noted that the horizontal connected units 33 are provided on a plurality of levels.

[0039]

On the other hand, a plurality of bottom plates 37 are formed when lower surfaces of the plurality of partition constituting the horizontal connected unit 36 on the lowermost level are formed flat, and a plurality of top panels 47 are formed when upper surfaces of the plurality of partitions constituting the horizontal connected unit on the uppermost level are formed flat (FIG. 1, and FIG. 6 to FIG. 9). The first to fourth cylindrical ribs 21 to 24 protruded on the lower surface of the partition main body 12b in a state that the partition 12 is turned over and installed so that the square tube rib 12 can extend upwardly are not formed on the bottom plate 37, and the insertion hole 12a and the fan-shaped through holes 12d are not formed either. That is, the bottom plate 37 has a bottom plate main body 37a having a square plate shape formed into the

same shape as the partition main body 12b, a bottom plate square tube rib 37b having a square frame shape protruded upward along an outer peripheral surface of the bottom plate main body 37a, and first to fourth
5 bottom plate cylindrical ribs 41 to 44 which are concentrically formed (FIG. 1, FIG. 6, and FIG. 7). Further, convex portions 37c and concave portions (not shown) are provided on four side surfaces of the bottom plate like the partition 12, and engagement holes 37e
10 (FIG. 7) are formed at four corner portions of the bottom plate 37, respectively. Furthermore, the convex portions 37c and the concave portions of the bottom plates 37 which are adjacent to each other are engaged like the partitions 12 which are adjacent to each other,
15 and these bottom plates 37 are connected through the first or second connecting member 31 or 32. As a result, the plurality of bottom plates 37 are laid out on the bottom surface of the storage tank, thereby constituting the horizontal connected body 36 on the lowermost level.

20 [0040]

The fifth to eighth cylindrical ribs 25 to 28 which are protruded on the upper surface of the partition main body 12b in a state that the square tube rib 12c is installed to extend downward are not formed on the top
25 panel 47, and the insertion hole 12a and the fan-shaped through holes 12d are not formed either. That is, the top panel 47 has a top panel main body 47a having a

square plate shape formed into the same shape as the partition main body 12b, a top panel square tube rib 47b having a square frame shape protruded downward along an outer peripheral surface of the top panel main body 47a, and first to fourth top panel cylindrical ribs 51 to 54 which are concentrically formed (FIG. 1, FIG. 8, and FIG. 9). Moreover, like the partition 12, convex portions 47c and concave portions (not shown) are provided on four side surfaces of the top panel 47 like the partition 12, and engagement holes 47e (FIG. 9) are formed at four corner portions of the top panel 47, respectively. Additionally, like the partitions 12 that are adjacent to each other, the convex portions 47c and the concave portions of the top panels 47 that are adjacent to each other are engaged, and these top panels 47 are connected through the first or second connecting member 31 or 32. As a result, the plurality of top panels 47 are arranged on the upper surface of the storage tank in close contact, thus configuring the horizontal connected unit 46 on the uppermost level. The bottom plates 37 and the top panels 47 are formed into the same shape by using plastic such as a polyolefin resin (polypropylene, polyethylene, or the like) or vinyl chloride resin. As a result, the number of steps for manufacturing molds of the bottom plates 37 and the top panels 47 can be reduced, the number of components can be decreased, and component management

can be facilitated. It is to be noted that reference sign 12k in FIG. 3 and FIG. 10 denotes a through hole formed on the inner side of a locking hole 12j in each of the four corner portions of the partition 12. A
5 small-diameter receiving pipe 56 is inserted into the through hole 12k placed on the outermost side of the partition 12 placed on the outermost side of the horizontal connected unit 33. This receiving pipe 56 is formed of, e.g., a vinyl chloride pipe, and it is
10 configured to receive a later-described foam plate 57 with the receiving rib 13b of the end spacer 13. Additionally, the receiving pipe 56 is formed with the same length as the spindle pipe 16.

[0041]

15 A procedure for assembling the thus configured storage composite 11 and putting into the storage tank will now be described. First, the ground is drilled into a rectangular parallelepiped shape having a predetermined depth, a bottom surface of this drilled
20 portion is compacted with gravel or sand, and then an impermeable sheet is spread so as to cover the bottom surface and a side surface of this drilled portion. In this state, the bottom plates 37 are aligned and laid on the bottom surface of the drilled portion from corners
25 of the drilled portion through the impermeable sheet, the convex portions 37c and the concave portions of the bottom plates 37 adjacent to each other are engaged, the

respective corners portions of the four bottom plates 37 adjacent to each other are coupled through the first connecting members 31, and the respective corner portions of the two bottom plates 37 which are placed on the outermost side and adjacent to each other are coupled through the second connecting members 32. As a result, the horizontal connected unit 36 on the lowest level is formed. Further, at the time of engaging the convex portions 37c and the concave portions of the bottom plates 37 adjacent to each other, directivity of each bottom plate 37 does not have to be taken into consideration, and hence assembling operability of the storage composite 11 is not spoiled.

[0042]

Then, the large-diameter tube portion 13a of each end spacer 13 is inserted into the fourth bottom plate cylindrical rib 44 of each bottom plate 37 constituting the horizontal connected unit 36 on the lowest level, a lower end of each connecting spacer 14 is inserted into the small-diameter tube portion 13b of this end spacer 13, the small-diameter tube portion 13b of a newly prepared end spacer 13 is fitted on the upper end of this connecting spacer 14, and then the fourth cylindrical rib 24 of a newly prepared partition 12 is fitted into the large-diameter tube portion 13a of this end spacer 13. Furthermore, the convex portions 12e and the concave portions 12f of the partitions 12 that are

adjacent to each other are engaged with each other, the respective corner portions of the four partitions 12 that are adjacent to each other are coupled through the first connecting members 31, and the respective corner portions of the two partitions 12 that are placed on the outermost side and adjacent to each other are coupled through the second coupling members 32. As a result, the horizontal connected unit 33 on the second level from the bottom is formed. Here, at the time of engaging the convex portions 12e and the concave portions 12f of the partitions 12 that are adjacent to each other, directivity of each partition 12 does not have to be taken into consideration, and hence assembling operability of the storage composite 11 is not spoiled. In this state, each spindle pipe 16 is inserted into the insertion hole 12a of each partition 12, and then the lower end of the spindle pipe 16 is inserted into the first bottom plate cylindrical rib 41 on each bottom plate 37, whereby the spindle pipe 16 is erected. At this time, since the lower end of each spindle pipe 16 abuts on the bottom plate main body 37a of each bottom plate 37, contact of the spindle pipe 16 with respect to the impermeable sheet can be avoided. As a result, the permeable sheet can be prevented from being damaged by the edge of each spindle pipe 16. Moreover, the small-diameter receiving pipe 56 is inserted into the through hole 12k of placed on the

outermost side in each partition 12 placed on the
outermost side of the horizontal connected unit 33 on
the second level from the bottom.

[0043]

5 As described above, since the convex portion 12e of
each partition 12 engages with the concave portion 12f
of the partition 12 adjacent to each partition 12 and
the concave portion 12f of each partition 12 engages
with the convex portion 12e of the partition 12 adjacent
10 to this partition 12, the adjacent partition 12 can be
prevented from being displaced in the vertical direction,
and the partitions 12 that are adjacent to each other
can be firmly coupled. As a result, the horizontal
connected unit 33 obtained by aligning the plurality of
15 partitions 12 on the same horizontal plane and coupling
them can be further structurally strengthened.

Additionally, even if an operator mounts the horizontal
connected unit 33 on the second level from the bottom,
each partition 12 is stably supported by each end spacer
20 13, and the partitions 12 that are adjacent to each
other are engaged with each other through the convex
portions 12e and the concave portions 12f, and hence the
partitions 12 that are adjacent to each other can be
assuredly prevented from being displaced in the vertical
25 direction. Further, since the upper and lower end
spacers 13 are connected by using the connecting spacer
14 having a smaller diameter than the large-diameter

tube portion 13a of each of these end spacers 13, starting materials used for manufacturing the spacers 13 and 14 can be reduced.

[0044]

5 Then, the large-diameter tube portion 13a of a newly prepared end spacer 13 is inserted into the eighth cylindrical rib 28 of each partition 12 constituting the horizontal connected unit 33 on the second level from the bottom, a lower end of the newly prepared connecting
10 spacer 14 is inserted into the small-diameter tube portion 13b of this end spacer 13, a small-diameter tube portion 13b of the newly prepared end spacer 13 is fitted to the upper end of this connecting spacer 14, and thereafter a fourth cylindrical rib 24 of the newly
15 prepared partition 12 is fitted into the large-diameter tube portion 13a of this end spacer 13. At this time, the insertion hole 12a of each partition 12 is fitted to the spindle pipe 16, and the through hole 12k of each partition 12 is fitted to the small-diameter receiving
20 pipe. Furthermore, the convex portions 12e and the concave portions 12f of the partitions 12 that are adjacent to each other are engaged, the respective corner portions of the four partitions 12 that are adjacent to each other are coupled through the first
25 connecting members 31, and the respective corner portions of the two partitions 12 that are placed on the outermost side and adjacent to each other are coupled

through the second coupling members 32. As a result, the horizontal connected unit 33 on the third level from the bottom is formed.

[0045]

5 Subsequently, the large-diameter tube portion 13a of a newly prepared end spacer 13 is inserted into the eighth cylindrical rib 28 of each partition 12 constituting the horizontal connected unit 33 on the third level from the bottom, a lower end of the newly
10 prepared connecting spacer 14 is inserted into the small-diameter tube portion 13b of this end spacer 13, a small-diameter tube portion 13b of the newly prepared end spacer 13 is fitted to the upper end of this connecting spacer 147, and thereafter the fourth top
15 plate cylindrical rib 54 of each top panel 47 is fitted to the large-diameter tube portion 13a of this end spacer 13. At this time, the first top panel cylindrical rib 51 of each top panel 47 is fitted in the spindle pipe 16. Furthermore, the convex portions 47c
20 and the concave portions of the top panels 47 that are adjacent to each other are engaged, the respective corner portions of the four top panels 47 that are adjacent to each other are coupled through the first connecting members 31, and the respective corner
25 portions of the two top panels 12 that are placed on the outermost side and adjacent to each other are coupled through the second connecting members 32. As a result,

the horizontal connected unit 46 on the highest level is formed. In this manner, the drilled portion is filled with the storage composite 11.

[0046]

5 Moreover, the foam plates 57 having a relatively small expansion ratio that is twentyfold to thirtyfold and having relatively high toughness are prepared. Additionally, the foam plates 57 are arranged to abut on the outermost surfaces of the receiving ribs 13f of the
10 plurality of end spacers 13 placed on the outermost side of the plurality of end spacers 13 and outer surfaces of the small-diameter receiving pipes 56 in the storage composites 11 filling the drilled portion. As a result, the plurality of foam plates 57 surround the end spacers
15 13 and the coupling spacers 14 between the horizontal connected unit 36 on the lowest level and the horizontal connected unit 33 on the second level from the bottom, surround the end spacers 13 and the connecting spacers 14 between the horizontal connected unit 36 on the
20 lowest level and the horizontal connected unit 33 on the second level from the bottom, surround the end spacers 13 and the connecting spacers 14 between the horizontal connected unit 33 on the second level from the bottom and the horizontal connected unit 33 on the third level
25 from the bottom, and surround the end spacers 13 and the connecting spacers 14 between the horizontal connected unit 33 on the third level from the bottom and the

horizontal connected unit 46 on the highest level. Here,
if the foam plates 57 may possibly fall, temporarily
fixing them by an adhesive tap is preferable. In this
state, an outer peripheral portion of the impermeable
5 sheet is mounted and laminated on the upper surface of
the storage composite 11, whereby the storage composite
11 are wrapped together with the foam plates 57 with the
impermeable sheet. At this time, since the upper end of
each spindle pipe 16 abuts on the top panel main body
10 47a of each top panel 47, contact of each spindle pipe
16 with respect to the impermeable sheet can be avoided.
As a result, the permeable sheet can be prevented from
being damaged by the edge of each spindle pipe 16.
Additionally, a gap between the side surface of the
15 drilled portion and the impermeable sheet is filled with
sand or soil.

[0047]

In the storage composite 11 filling the storage
tank in this manner, the horizontal connected units 36,
20 33, 33, and 46 configured by aligning the plurality of
partitions 12 on the same horizontal plane and
connecting them are provided on the plurality of levels
(four levels), the end spacers 13 and the connecting
spacers 14 are interposed between the horizontal
25 connected units 36, 33, 33, and 46 on the plurality of
levels, and each spindle pipe 16 is vertically inserted
into the insertion hole 12a of each partition 12

constituting each of the horizontal connected units 33
and 33 on the plurality of levels, and hence each
spindle pipe 16, each end spacer 13, and each connecting
spacer 14 receive a partial pressure along the vertical
5 direction in external force acting on the storage
composite 11 whilst the horizontal connected units 33,
33, and 46 mainly receive a partial pressure along the
horizontal direction in the external force acting on the
storage composite 11. As a result, even the storage
10 composite 11 formed by assembling the members having
relatively simple shapes can assure strength as a
relatively large structure. Further, since the
partitions 12, the end spacers 13, and the connecting
spacers 14 having the relatively simple shapes are used,
15 the number of steps for manufacturing molds that are
used to mold these members can be reduced. Furthermore,
since the storage composite 11 is wrapped together with
the foam plates 57 with the impermeable sheet, even if
the partial pressure along the horizontal direction in
20 the external force acting on the storage composite 11
acts on the impermeable sheet in a pressure-welding
direction, the large-area flat surface of each foam
plate 57 receives this external pressure. As a result,
the impermeable sheet can be prevented from being
25 damaged.

[0048]

<Second Embodiment>

FIG. 15 shows a second embodiment according to the present invention. In FIG. 15, like reference numerals denote the same components as those in FIG. 1. In this embodiment, horizontal connected units 36, 33, and 46 on a plurality of levels are configured so as to have a larger vertical interval on the upper side than on the lower side. That is, the horizontal connected unit 33 on the third level from the bottom according to the first embodiment is omitted. Moreover, in place of the end spacers 13 and 13 connected with the lower surface and the upper surface of the horizontal connected unit 33 on the third level from the bottom and the connecting spacers 14 connected to these end spacers 13 and 13 according to the first embodiment, each elongated connecting spacer 74 is used. A lower end of this elongated connecting spacer 74 is inserted into a small-diameter tube portion 13b of an end spacer 13 connected with an upper surface of a partition 12 constituting a horizontal connected unit 33 on the second level from the bottom, and an upper end of the elongated connecting spacer 74 is inserted into the small-diameter tube portion 13b of the end spacer 13 connected with a lower surface of a top panel 47 constituting a horizontal connected unit 46 on the highest level. Additionally, a plurality of slots 74a are formed in each elongated connecting spacer 74. These slots 74a are formed to prevent an air pocket from being generated in the

elongated connecting spacer 74 by introducing rainwater or the like stored in a storage tank into the elongated connecting spacer 74. Other structures are configured in the same manner as the first embodiment.

5 [0049]

In a storage composite 71 configured in this manner, since the horizontal connected units 36, 33 and 46 on the plurality of levels are configured to have a larger vertical interval on the upper side than on the lower
10 side, strength on the upper side can be reduced, and structural wastes can be omitted. Operations and effects other than those described above are substantially the same as those of the first embodiment, and hence an overlapping description will be omitted.

15 [0050]

<Third Embodiment>

FIG. 16 to FIG. 20 show a third embodiment according to the present invention. In FIG. 16 to FIG. 20, like reference numerals denote the same components
20 as those in FIG. 1 to FIG. 14. In this embodiment, in place of the end spacers 13 and the connecting spacers 14 according to the first embodiment, each cylindrical spacer 93 is used. Further, partitions 12, spindle pipes 16, bottom plates 37, top panels 47, first
25 connecting members 31, second connecting members 32, a horizontal connected unit 33, a horizontal connected unit 36 on the lowest level, a horizontal connected unit

46 on the highest level, and receiving pipes 56 are formed into the same shapes as those in the first embodiment. Specifically, a storage composite 91 has the plurality of square-plate-like partitions 12 each having an insertion hole 12a at the center, the plurality of cylindrical spacers 93 connected to lower surfaces and upper surfaces of the partitions 12, and the spindle pipes 16 inserted into the insertion holes 12a of the partitions 12. First to fourth cylindrical ribs 21 to 24 are protruded on the lower surface of each partition 12 concentrically with the insertion hole 12, and fifth to eighth cylindrical ribs 25 to 28 are protruded on the upper surface of each partition 12 concentrically with the insertion hole 12a.

[0051]

Furthermore, as the spacers 93, three types of first to third spacers 93a to 93c having different diameters are used (FIG. 16 and FIG. 17). The thickest first spacer 93a is movably inserted into a ring groove between the third cylindrical rib 23 and the fourth cylindrical rib 24 on a lower surface of each partition 12, movably inserted into a ring groove between the seventh cylindrical rib 27 and the eighth cylindrical rib 28 on an upper surface of each partition 12, movably inserted into a ring groove between a third bottom plate cylindrical rib 43 and a fourth bottom plate cylindrical rib 44 on an upper surface of each bottom plate 37, or

movably inserted into a ring groove between a third top panel cylindrical rib 53 and a fourth top panel cylindrical rib 54 on a lower surface of each top panel 47. Furthermore, the second spacer 93b having the

5 second thickness is movably inserted into a ring groove between the second cylindrical rib 22 and the third cylindrical rib 23 on the lower surface of each partition 12, movably inserted into a ring groove between the sixth cylindrical rib 26 and the seventh

10 cylindrical rib 27 on the upper surface of each partition 12, movably inserted into a ring groove between a second bottom plate cylindrical rib 42 and the third bottom plate cylindrical rib 43 on the upper surface of each bottom plate 37, or movably inserted

15 into a ring groove between a second top panel cylindrical rib 52 and the third top panel cylindrical rib 53 on the lower surface of each top panel 47. Moreover, the thinnest third spacer 93c is movably inserted into a ring groove between the first

20 cylindrical rib 21 and the second cylindrical rib 22 on the lower surface of each partition 12, movably inserted into a ring groove between the fifth cylindrical rib 25 and the sixth cylindrical rib 26 on the upper surface of each partition, movably inserted into a ring groove

25 between a first bottom plate cylindrical rib 41 and the second bottom plate cylindrical rib 42 on the upper surface of each bottom plate 37, or movably inserted

into a ring groove between a first top panel cylindrical
rib 51 and the second top panel cylindrical rib 52 on
the lower surface of the top panel 47. That is, each
spacer 13 is connected to the upper surface or the lower
5 surface of each partition 12 so as to be movably
inserted into one of the plurality of ring grooves
between the plurality of cylindrical ribs 21 to 28,
connected to the upper surface of each bottom plate 37
so as to be movably inserted into one of the plurality
10 of ring grooves between the plurality of bottom plate
cylindrical ribs 41 to 44, or connected to the lower
surface of each top panel 47 so as to be movably
inserted into one of the plurality of ring grooves
between the plurality of top panel cylindrical ribs 51
15 to 54.

[0052]

Although the thickest first spacer 93a is
interposed between the bottom plate 37 and the partition
12, between the partition 12 and the partition 12, or
20 between the partition 12 and the top panel 47 that are
placed on the outermost side of each of the plurality of
horizontal connected units 36, 33, 33, and 46 on the
four levels, one of the second and third spacers 93b and
93c is interposed at any other position. Additionally,
25 a plurality of slots 93d to 93f extending in the
vertical direction are formed in the first to third
spacers 93a to 93c, respectively (FIG. 16 and FIG. 18 to

FIG. 20). These slots 93d to 93f are formed to prevent an air pocket from being generated in the first to third spacers 93a to 93c by rapidly introducing rainwater or the like stored in a storage tank into the first to
5 third spacers 93a to 93c. It is to be noted that although the three types of cylindrical spacers having the different diameters are used in this embodiment, two types of spacers having different diameters or one type of cylindrical spacer may be used, a circular truncated
10 conical spacer having different diameters at an upper end and a lower end may be used. Other structures are configured in the same manner as the first embodiment.
[0053]

A procedure for assembling a storage composite 91
15 configured in this manner and filling the storage tank with this storage composite 11 will now be described. First, the ground is drilled into a rectangular parallelepiped shape having a predetermined depth, a bottom surface of this drilled portion is compacted with
20 gravel or sand, and then an impermeable sheet is spread so as to cover the bottom surface and a side surface of this drilled portion. In this state, bottom plates 37 are aligned and laid on the bottom surface of the drilled portion from corners of the drilled portion
25 through the impermeable sheet, convex portions 37c and concave portions (not shown) of the bottom plates 37 adjacent to each other are engaged, the respective

corner portions of the four bottom plates 37 adjacent to each other are coupled through first connecting members 31, and the respective corner portions of the two bottom plates 37 which are placed on the outermost side and
5 adjacent to each other are coupled through second connecting members 32. As a result, the horizontal connected unit 36 on the lowest level is formed.

Further, at the time of engaging the convex portions 37c and the concave portions of the bottom plates 37

10 adjacent to each other, directivity of each bottom plate 37 does not have to be taken into consideration, and hence assembling operability of the storage composite is not spoiled.

[0054]

15 Then, the thickest first spacer 93a is movably inserted into the ring groove between the third and fourth bottom plate cylindrical ribs 43 and 44 of each bottom plate 37 placed on the outermost side of the horizontal connected unit 36 on the lowest level, one of
20 the second and third spacers 93b and 93c is movably inserted into one of the three ring grooves between the first to fourth bottom plate cylindrical ribs 41 to 44 on each bottom plate 37 placed at any other position, and then one of the three ring grooves between the first
25 to fourth cylindrical ribs 21 to 24 on each partition 12 is movably fitted on the upper end of each of these spacers 93a to 93c. Moreover, the convex portions 12e

and the concave portions 12f of the partitions 12 that are adjacent to each other are engaged, the respective corner portions of the four partitions 12 that are adjacent to each other are coupled through the first
5 connecting members 31, and the respective corner portions of the two partitions 12 that are placed on the outermost side and adjacent to each other are coupled through the second connecting members 32. As a result, the horizontal connected unit 33 on the second level
10 from the bottom is formed. Here, at the time of engaging the convex portions 12e and the concave portions 12f of the partitions 12 that are adjacent to each other, since directivity of each partition 12 does not have to be taken into consideration, assembling
15 operability of the storage composite 91 is not spoiled. In this state, each spindle pipe 16 is inserted into the insertion hole 12a of each partition 12, and then the lower end of each spindle pipe 16 is inserted into the first bottom plate cylindrical rib 41 on each bottom
20 plate 37, whereby each spindle pipe 16 is erected. At this time, since the lower end of the spindle pipe 16 abuts on the bottom plate main body 37a of the bottom plate 37, contact of the spindle pipe 16 with respect to the impermeable sheet can be avoided. As a result, a
25 permeable sheet can be prevented from being damaged by an edge of each spindle pipe 16. Further, a small-diameter receiving pipe 56 having the same length as the

spindle pipe 16 is inserted into a through hole 12k placed on the outermost side of each partition 12 placed on the outermost side of the horizontal connected unit 33 on the second level from the bottom.

5 [0055]

As described above, since the convex portion 12e of each partition 12 engages with the concave portion 12f of the partition 12 adjacent to this partition 12 and the concave portion 12f of the partition 12 engages with
10 the convex portion 12e of the partition 12 adjacent to this partition 12, the adjacent partition 12 can be prevented from being displaced in the vertical direction, and the partitions 12 adjacent to each other can be firmly coupled. As a result, each horizontal connected
15 unit 33 obtained by aligning the plurality of partitions 12 on the same horizontal plane and coupling them can be further structurally strengthened. Furthermore, since the partitions 12 that are adjacent to each other are engaged through the convex portions 12e and the concave
20 portions 12f, the partitions 12 adjacent to each other can be assuredly prevented from being displaced in the vertical direction. Moreover, when waste pipes are used as the first to third spacers 93a to 93c, the waste pipes having difficulty in disposal can be effectively
25 used.

[0056]

Then, each of newly prepared first to third spacers

93a to 93c is movably inserted into one of the three ring grooves between the first to eighth cylindrical ribs 25 to 28 of each partition 12 constituting the horizontal connected unit 33 on the second level from the bottom. At this time, the thickest first spacer 93a is movably inserted between the third and fourth bottom plate cylindrical ribs 23 and 24 of the partition 12 placed on the outermost side of the horizontal connected unit 33 on the second level from the bottom. One of the three ring grooves between the first to fourth cylindrical ribs 21 to 24 of the newly prepared partition 12 is movably fitted to the upper end of each of the first to third spacers 93a to 93c. At this time, the insertion hole 12a of partition 12 is fitted with respect to the spindle pipe 16, and the through hole 12k of the partition 12 is fitted with respect to the small-diameter receiving pipe 56. Moreover, the convex portions 12e and the concave portions 12f of the partitions 12 adjacent to each other are engaged, and the respective corner portions of the four partitions 12 adjacent to each other are coupled through the first connecting members 31, and the respective corner portions of the two partitions 12 that are placed on the outermost side and adjacent to each other are coupled through the second connecting members 32. As a result, the horizontal connected unit 33 on the third level from the bottom is formed.

[0057]

Subsequently, each of the newly prepared first to third spacers 93a to 93c is movably inserted into one of the three ring grooves between the fifth to eighth
5 cylindrical ribs 25 to 28 of each partition constituting the horizontal connected unit 33 on the third level from the bottom. At this time, the thickest first spacer 93a is movably inserted between the third and fourth bottom plate cylindrical ribs 23 and 24 of the partition placed
10 on the outermost side of the horizontal connected unit 33 on the third level from the bottom. Each of the three ring grooves between the first to fourth top panel cylindrical ribs 53 to 54 of each top panel 47 is movably fitted on the upper end of each of the first to
15 third spacers 93a to 93c. At this time, the first top panel cylindrical rib 51 of each top panel 47 is fitted in the spindle pipe 16. Additionally, the convex portions 47c and the concave portions (not shown) of the top panels 47 which are adjacent to each other are
20 engaged, the respective corner portions of the four top panels 47 that are adjacent to each other are coupled through the first connecting members 31, and the respective corner portions of the two top panels 12 that are placed on the outermost side and adjacent to each
25 other are coupled through the second connecting members 32. As a result, the horizontal connected unit 46 on the highest level is formed. In this manner, the

drilled portion is filled with the storage composite 91.
[0058]

Further, the foam plates 57 having a relatively small expansion ratio that is twentyfold to thirtyfold
5 and having relatively high toughness are prepared. Additionally, the foam plates 57 are arranged to abut on the outermost surfaces of the plurality of first spacers 93a placed on the outermost side in the first to third spacers 93a to 93c and outer surfaces of the small-
10 diameter receiving pipes 56 in the storage composite 91 filling the drilled portion. As a result, the plurality of foam plates 57 surround the first to third spacers 93a to 93c between the horizontal connected unit 36 on the lowest level and the horizontal connected unit 33 on
15 the second level from the bottom, surround the first to third spacers 93a to 93c between the horizontal connected unit 33 on the second level from the bottom and the horizontal connected unit 33 on the third level from the bottom, and surround the first to third spacers
20 93a to 93c between the horizontal connected unit 33 on the third level from the bottom and the horizontal connected unit 46 on the highest level. Here, if the foam plates 57 may possibly fall, temporarily fixing them by an adhesive tap is preferable. In this state,
25 an outer peripheral portion of the impermeable sheet is mounted and laminated on the upper surface of the storage composite 11, whereby the storage composite 91

is wrapped together with the foam plates 57 with the impermeable sheet. At this time, since the upper end of each spindle pipe 16 abuts on the top panel main body 47a of each top panel 47, contact of each spindle pipe 16 with respect to the impermeable sheet can be avoided. As a result, the permeable sheet can be prevented from being damaged by the edge of each spindle pipe 16. Additionally, a gap between the side surface of the drilled portion and the impermeable sheet is filled with sand or soil.

[0059]

In the storage composite 91 filling the storage tank in this manner, the horizontal connected units 36, 33, 33, and 46 configured by aligning the plurality of partitions 12 on the same horizontal plane and connecting them are provided on the plurality of levels (four levels), the first to third spacers 93a to 93c are interposed between the horizontal connected units 36, 33, 33, and 46 on the plurality of levels, and each spindle pipe 16 is vertically inserted into the insertion hole 12a of each partition 12 constituting each of the horizontal connected units 33 and 33 on the plurality of levels, and hence each spindle pipe 16 and each spacer 13 receive a partial pressure along the vertical direction in external force acting on the storage composite 91 whilst the horizontal connected units 33 which are integrated by coupling the plurality of levels

in the vertical direction by each spindle pipe 16
receive a partial pressure along the horizontal
direction in the external force acting on the storage
composite 91. As a result, even the storage composite
5 91 formed by assembling the members having relatively
simple shapes can assure strength as a relatively large
structure. Furthermore, since the storage composite 91
is wrapped together with the foam plates 57 with the
impermeable sheet, even if the partial pressure along
10 the horizontal direction in the external force acting on
the storage composite 91 acts on the impermeable sheet
in a pressure-welding direction, the large-area flat
surface of each foam plate 57 receives this external
pressure. As a result, the impermeable sheet can be
15 prevented from being damaged.

[0060]

<Fourth Embodiment>

FIG. 21 to FIG. 24 show a fourth embodiment
according to the present invention. In FIG. 21 to FIG.
20 24, like reference numerals denote the same components
as those in FIG. 1, FIG. 6, and FIG. 8. In this
embodiment, each partition 112 has a partition main body
112b having a square plate shape with an insertion hole
112a formed at the center and a square tube rib 112c
25 having a square frame shape protruded on the entire
outer periphery of the partition main body 112b above
and below this partition main body 112b (FIG. 22 to FIG.

24). Further, like the first embodiment, four first to fourth cylindrical ribs 21 to 24 are protruded on the lower surface of the partition main body 112b in the same direction (downward) as a protruding direction of the square tube rib 112c concentrically with the insertion hole 112a, and four fifth to eighth cylindrical ribs 25 to 28 are protruded on the upper surface of the partition main body 112b in the opposite direction (upward) of the protruding direction of the square tube rib 112c concentrically with the insertion hole 112a, respectively. The partition main body 112b, the square tube rib 112c, and the first to eighth cylindrical ribs 21 to 28 are integrally molded by using plastic such as a polyolefin resin (polypropylene, polyethylene, or the like) or a vinyl chloride resin. Further, at least one cylindrical rib protruded on the lower surface of the partition 112 corresponds to the fourth cylindrical rib 24, and at least one cylindrical rib protruded on the upper surface of the partition 112 corresponds to the eighth cylindrical rib 28.

[0061]

It is to be noted that a plurality of reinforcing ribs 112d are extended and provided at portions between the square tube rib 112c of the partition main body 12b and the fourth and eighth cylindrical ribs 24 and 28 except four corner portions in a substantially double-cross pattern, and a plurality of substantially square

through holes 112e are formed between these reinforcing ribs 112d (FIG. 24). Furthermore, a plurality of reinforcing ribs 112f are extended and provided at the four corner portions of the partition main body 112b in a radial pattern, and a plurality of circular through holes 112g are formed in the partition main body 112b between these reinforcing ribs 112f. These through holes 112e and 112g are formed to spread rainwater or the like stored in a storage tank to the respective portions and prevent an air pocket from being generated in the storage tank. Moreover, reference sign 112h in FIG. 24 represents an engagement hole which is provided at each of the four corner portions of the partition main body 112b and with which a first or second engagement protrusion of a first or second connecting member that connects the adjoining partitions 112 with each other engages.

[0062]

On the other hand, a convex portion 113 and a concave portion 114 are provided on each of four side surfaces of the partition 112. The convex portion 113 is formed of a plurality of first convex portions 113a having a rectangular plate shape which are provided on an outer peripheral surface of the square tube rib 112c on an upper side of the partition main body 112b along a longitudinal direction of the outer peripheral surface of the square tube rib 112c at predetermined intervals

and a plurality of second convex portions 113b having a rectangular plate shape which are provided on the outer peripheral surface of the square tube rib 112c on a lower side of the partition main body 112b along the longitudinal direction of the outer peripheral surface of the square tube rib 112c at predetermined intervals (FIG. 22 to FIG. 24). Furthermore, the concave portion 114 is formed of a first concave portion 114a provided between the plurality of first convex portions 113a and a second concave portion 114b provided between the plurality of second convex portions 113b. Moreover, each first convex portion 113a is placed immediately below the second concave portion 114b, and the second convex portion 113b is placed immediately above the first concave portion 114a, whereby the first and second convex portions 113a and 113b and the first and second concave portions 114a and 114b are arranged on the outer peripheral surface of the square tube rib 112c in a reticular pattern (FIG. 24). Additionally, the first concave portion 114a is formed into a relatively shallow square shape associated with the first or second convex portion 113a or 113b, and the second concave portion 114b is formed into a relatively shallow square shape associated with the first or second convex portion 113a or 113b. Further, each first convex portion 113a of the partition 112 engages with the first or second concave portion 114a or 114b of the partition 112 adjacent to

this partition 112, and each second convex portion 113b of the partition 112 engages with the second or first concave portion 114b or 114a of the partition 112 adjacent to this partition 112 (FIG. 22 to FIG. 24). It is to be noted that, although not shown, to couple the partitions 112 that are adjacent to each other through the first or second connecting member, it is preferable to reduce heights of the reinforcing ribs 112f at the four corner portions and the square tube rib 112c of each partition 112, increase a thickness of the first or second connecting member, and form concave grooves in portions facing the reinforcing ribs 112f and the square tube rib 112c.

[0063]

On the other hand, each of a plurality of bottom plates 118 constituting a horizontal connected unit 117 on the lowest level has a bottom plate main body 118a having a square plate shape and a bottom plate square tube rib 118b having a square frame shape which is protruded on this bottom plate main body 118a over the entire outer periphery of the bottom plate main body 118a (FIG. 21 and FIG. 22). On an outer peripheral surface of the bottom plate square tube rib 118b, a bottom plate convex portion 118c and a bottom plate concave portion 118d are alternately formed along a longitudinal direction of the outer peripheral surface of the bottom plate square tube rib 118b (FIG. 22). The

bottom plate convex portion 118c is formed into the same shape as the first convex portion 113a, and the bottom plate concave portion 118d is formed into the same shape as the first concave portion 114a. Further, each of a plurality of top panels 122 constituting a horizontal connected unit 121 on the highest level has a top panel main body 122a having a square plate shape and a top panel angle tube rib 122b having a square frame shape which is protruded below this top panel main body 122a over the entire outer periphery of the top panel main body 122a (FIG. 21 and FIG. 23). On an outer peripheral surface of the top panel angle tube rib 122b, a top panel convex portion 122c and a top panel concave portion 122d are alternately formed along a longitudinal direction of the outer peripheral surface of the top panel square tube rib 122b (FIG. 23). The top panel convex portion 122c is formed into the same shape as the second convex portion 113b, and the top panel concave portion 122d is formed into the same shape as the second concave portion 114b. Further, the bottom plate convex portion 118c and the bottom plate concave portion 118d of the bottom plate 118 engage with the bottom plate concave portion 118d and the bottom plate convex portion 118c of the bottom plate 118 adjacent to this bottom plate 118, and the top panel convex portion 122c and the top panel concave portion 122d of the top panel 122 engage with the top panel concave portion 122d and the

top panel convex portion 122c of the top panel 122 adjacent to this top panel 122, respectively. Other structures are the same as those in the first embodiment.

[0064]

5 In the thus configured storage composite 111, even if the partitions 12 are turned over or any one of the four outer peripheral surfaces of the partition 112 is appressed against the partition 112 adjacent to this partition 112, the first convex portion 113a of the
10 partition 112 engages with the first or second concave portion 114a or 114b of the partition 112 adjacent to this partition 112, and the second convex portion 113b of the partition 112 engages with the second or first concave portion 114b or 114a of the partition 112
15 adjacent to this partition 112. As a result, the partitions 112 can be relatively easily laid out. Further, since it is possible to assuredly avoid a displacement in a direction vertical to the adjacent partition 112 and a displacement in a direction
20 horizontal to the same, the partitions 112 which are adjacent to each other can be firmly coupled. Furthermore, since the end surfaces of the first and second convex portions 113a and 113b protruding on the outer peripheral surface of the horizontal connected
25 unit 116 obtained by aligning the plurality of partitions 112 on the same horizontal plane and connecting the same are flat surfaces each having a

relatively large area, a member that is inserted along the outer peripheral surface of the horizontal connected unit 116 (e.g., the foam plate 57) or a member facing the outer peripheral surface of the horizontal connected unit 116 (e.g., the impermeable sheet or the permeable sheet) cannot be damaged.

[0065]

On the other hand, even if any one of the four outer peripheral surfaces of the bottom plate 118 is appressed against the bottom plate 118 adjacent to this bottom plate 118, the bottom plate convex portion 118c and the bottom plate concave portion 118d of the bottom plate 118 engage with the bottom plate concave portion 118d and the bottom plate convex portion 118c of the bottom plate 118 adjacent to this bottom plate 118, respectively. As a result, the bottom plates 118 can be relatively easily laid out. Moreover, even if any one of the four outer peripheral surfaces of the top panel 122 is appressed against the top panel 122 adjacent to this top panel 122, the top panel convex portion 122c and the top panel concave portion 122d of the top panel 122 engage with the top panel concave portion 122d and the top panel convex portion 122c of the top panel 122 adjacent to this top panel 122, respectively. As a result, the top panels 122 can be relatively easily laid out. Operations other than those described above are substantially the same as the operations in the first

embodiment, and hence overlapping explanation will be omitted.

[0066]

It is to be noted that the storage tank filled with
5 the storage composite has been taken as an example in
the first to fourth embodiments, but a permeable storage
tank filled with the storage composite may be used.
This permeable storage tank is formed by graveling a
bottom surface and a side surface of a drilled portion
10 formed by drilling the ground to form a permeable layer
or covering the bottom surface or the side surface of
the drilled portion with a permeable sheet (a sheet
through which rainwater gradually passes). According to
this permeable storage tank, at the time of heavy rain
15 whose rain intensity exceeds a discharge capacity of a
sewage pipe or the like, rainwater that has flowed into
the permeable tank is temporarily stored in this
permeable tank, and then it seeps and spreads
underground. As a result, the sewage pipe or a river
20 can be prevented from overflowing. The permeable
storage tank is filled with the storage composite
according to the present invention, and foam plates are
applied to the outermost surfaces of a plurality of end
spacers placed on the outermost side of a plurality of
25 end spacers of the filling storage composite, whereby
the foam plates are configured to surround the plurality
of end spacers and connecting spacers between respective

horizontal connected units on a plurality of levels.
Here, in case of wrapping the storage composite together
with the foam plates with a permeable sheet, even if a
horizontal partial pressure in an external pressure
5 acting on the storage composite acts on the permeable
sheet in a pressure-welding direction, a large-area flat
surface of each foam plate receives this external
pressure. As a result, an impermeable sheet can be
prevented from being damaged.

10 [0067]

Furthermore, in the first to fourth embodiments,
the four cylindrical ribs are provided on each of the
lower surface and the upper surface of each partition,
the four bottom plate cylindrical ribs are provided on
15 the upper surface of each bottom plate, and the four top
panel cylindrical ribs are provided on the lower surface
of each top panel, but three, five, or more cylindrical
ribs may be provided on each of such surfaces. Moreover,
the horizontal connected units are provided on the four
20 levels in the first, third, and fourth embodiments, but
these units may be provided on three, five, or more
levels, and the horizontal connected units are provided
on the three levels in the second embodiment, but these
units may be provided on four or more levels.
25 Additionally, although the description has been given as
to the underground storage tank that is completely
buried underground in the first to fourth embodiments,

it is possible to adopt an aboveground storage tank that is installed on the ground without being completely buried or a semi-underground storage tank which is installed in such a manner that a lower portion thereof is buried underground and an upper portion thereof protrudes on the ground. Further, although the bottom plates and the top panels are used in the first to fourth embodiments, the partitions may be used as they are in place of the bottom plates and the top panels when a sheet for wrapping the storage composite is not used.

INDUSTRIAL APPLICABILITY

[0008]

The storage composite according to the present invention can reduce the number of steps for manufacturing molds, which are used to form members, e.g., the partitions, the spacers, and others each having a relatively simple shape, by using these members, and it can be used as a filling material in the storage tank and the permeable storage tank.

EXPLANATIONS OF LETTERS OR NUMERALS

[0069]

11, 71, 91, 111 storage composite
12, 112 partition
12a, 112a insertion hole

12e, 113 convex portion
 12f, 114 concave portion
 13 end spacer
 13a large-diameter tube portion
 5 13b small-diameter tube portion
 14, 74 connecting spacer
 16 spindle pipe
 21 to 28 cylindrical rib
 33, 36, 46, 116 horizontal connected unit
 10 37 bottom plate
 47 top panel
 57 foam plate
 93 spacer
 113a first convex portion
 15 113b second convex portion
 114a first concave portion
 114b second concave portion

CLAIMS

1. A storage composite which fills the inside of a storage tank or a permeable storage tank, comprising:

a plurality of partitions having a square plate shape, each of which has at least one cylindrical rib protruded on a lower surface thereof and at least one cylindrical rib protruded on an upper surface thereof;

a plurality of funnel-shaped end spacers, each of which has a large-diameter cylindrical portion that is connected to one or both of the lower surface and the upper surface of the partition while being fitted on the cylindrical rib, and a small-diameter cylindrical

portion which is integrally formed with the large-diameter cylindrical portion and formed with a diameter smaller than the large-diameter cylindrical portion; and

a plurality of cylindrical connecting spacers, each of which has both ends fitted in the small-diameter cylindrical portions of a pair of end spacers facing each other and extends in a vertical direction,

wherein a diameter T of a portion of the cylindrical rib fitted into the large-diameter cylindrical portion is set to fall within the range of $0.40S$ to $0.95S$ where S is a length of one side of the partition,

horizontal connected units, each of which is configured by aligning the plurality of partitions on the same horizontal plane and coupling them, are

provided on a plurality of levels, and

the end spacers and the connecting spacers are interposed between the horizontal connected units on the plurality of levels.

5

2. The storage composite according to claim 1,

wherein an insertion hole is formed at the center of each of the plurality of partition, and a spindle pipe is vertically inserted into the insertion hole of

10 each partition constituting each of the horizontal connected units on the plurality of levels.

3. The storage composite according to claim 1,

15 wherein a plurality of bottom plates are formed by flatly forming a lower surface of each of the plurality of partitions constituting the horizontal connected unit on the lowest level, and

a plurality of top panels are formed by flatly forming an upper surface of each of the plurality of partition constituting the horizontal connected unit on
20 the highest level.

4. The storage composite according to claim 1,

25 wherein each vertical interval between the horizontal connected units on the plurality of levels is configured to be larger on an upper side than on a lower side.

5. The storage composite according to claim 1,

wherein a convex portion and a concave portion are provided on each of four side surfaces of the partition, the convex portion of the partition engages with the concave portion of a partition adjacent to the partition, and the concave portion of the partition engages with the convex portion of a partition adjacent to the partition.

10

6. The storage composite according to claim 5,

wherein the partition comprises: a partition main body having a square plate shape; and a square tube rib having a square frame shape protruded on each of an upper side and a lower side of the partition main body over an entire outer periphery of the partition main body,

15

the convex portion comprises: a plurality of first convex portions having a rectangular plate shape which are provided on an outer peripheral surface of the square tube rib above the partition main body in a longitudinal direction of the outer peripheral surface of the square tube rib at predetermined intervals; and a plurality of second convex portions having a rectangular plate shape which are provided on the outer peripheral surface of the square tube rib below the partition main body in the longitudinal direction of the outer peripheral surface of the square tube rib at

20

25

predetermined intervals,

the concave portion comprises: a first concave portion provided between the plurality of first convex portions; and a second concave portion provided between
5 the plurality of second convex portions,

the first convex portion is placed immediately below the second concave portion, the second convex portion is placed immediately above the first concave portion, and the first and second convex portions and
10 the first and second concave portions are thereby arranged on the outer peripheral surface of the square tube rib in a reticular pattern, and

the first convex portion of the partition engages with the first or second concave portion of a partition
15 adjacent to the partition, and the second convex portion of the partition engages with the second or first concave portion of the partition adjacent to the partition.

20 7. A storage composite which fills the inside of a storage tank or a permeable storage tank, comprising:

a plurality of partitions having a square plate shape, each of which has an insertion hole formed at the center, a plurality of cylindrical ribs protruded on a
25 lower surface thereof concentrically with the insertion hole, and a plurality of cylindrical ribs protruded on an upper surface thereof concentrically with the

insertion hole;

a plurality of frustum cylindrical or cylindrical
spacers connected to one or both the lower surface and
the upper surface of the partition so as to be movably
5 inserted into any one of a plurality of ring grooves
between the plurality of cylindrical ribs; and

a spindle pipe inserted into the insertion hole of
each partition,

wherein horizontal connected units, which are
10 configured by aligning the plurality of partition on the
same horizontal plane and coupling them, are provided on
a plurality of levels,

the spacer is interposed between the horizontal
connected units on the plurality of levels;

15 the spindle pipe is vertically inserted into the
insertion hole of each of the partitions constituting
the horizontal connected units on the plurality of
levels,

a convex portion and a concave portion are provided
20 on each of four side surfaces of the partition,

the convex portion of the partition engages with
the concave portion of a partition adjacent to the
partition, and

the concave portion of the partition engages with
25 the convex portion of a partition adjacent to the
partition.

8. The storage composite according to claim 7,

wherein the partition comprises: a partition main body having a square plate shape, which has an insertion hole formed at the center; and a square tube rib having
5 a square frame shape protruded on each of an upper side and a lower side of the partition main body over an entire outer periphery of the partition main body,

the convex portion comprises: a plurality of first convex portions having a rectangular plate shape which
10 are provided on an outer peripheral surface of the square tube rib above the partition main body in a longitudinal direction of the outer peripheral surface of the square tube rib at predetermined intervals; and a plurality of second convex portions having a rectangular
15 plate shape which are provided on the outer peripheral surface of the square tube rib below the partition main body in the longitudinal direction of the outer peripheral surface of the square tube rib at predetermined intervals,

20 the concave portion comprises: a first concave portion provided between the plurality of first convex portions; and a second concave portion provided between the plurality of second convex portions,

the first convex portion is placed immediately
25 below the second concave portion, the second convex portion is placed immediately above the first concave portion, and the first and second convex portions and

the first and second concave portions are thereby arranged on the outer peripheral surface of the square tube rib in a reticular pattern, and

the first convex portion of the partition engages
5 with the first or second concave portion of a partition adjacent to the partition, and the second convex portion of the partition engages with the second or first concave portion of the partition adjacent to the partition.

10

9. A storage tank,

wherein the storage tank is filled with the storage composite according to any one of claims 1 to 6, and foam plates abut on the outermost surfaces of a
15 plurality of end spacers placed on the outermost side of a plurality of end spacers in the filling storage composite, and the foam plates thereby surround the end spacers and the connecting spacers between the horizontal connected units on the plurality of stages.

20

10. A storage tank,

wherein the storage tank is filled with the storage composite according to claim 7 or 8, and foam plates abut on the outermost surfaces of a plurality of spacers
25 placed on the outermost side of a plurality of spacers in the filling storage composite, and the foam plates thereby surround the plurality of spacers between the

horizontal connected units on the plurality of stages.

11. A permeable storage tank,

wherein the permeable storage tank is filled with
5 the storage composite according to any one of claims 1
to 6, and foam plates abut on the outermost surfaces of
a plurality of end spacers placed on the outermost side
of a plurality of end spacers in the filling storage
composite, and the foam plates thereby surround the end
10 spacers and the connecting spacers between the
horizontal connected units on the plurality of stages.

12. A permeable storage tank,

wherein the permeable storage tank is filled with
15 the storage composite according to claim 7 or 8, and
foam plates abut on the outermost surfaces of a
plurality of spacers placed on the outermost side of a
plurality of spacers in the filling storage composite,
and the foam plates thereby surround the plurality of
20 spacers between the horizontal connected units on the
plurality of stages.