TITLE OF INVENTION: HOLCIM FLOATCRETE

SPECIFICATIONS / DESCRIPTION

In today's situation when in cities like Singapore, the land availability is scarce, whereas enough water bodies available. In view of this, it was thought if we can utilized these water bodies for installation like solar panels, floating green bodies, providing pedestrian and light vehicle movements by creating floating connectors which would be very economical comparing to building bridges and also highly durable like conventional bridges.

The above mentioned needed a solution and thus it makes this invention revolutionary, green and beneficial to environment at large.

Holcim Floatcrete concrete is a specialty product developed having density lighter than water around 700 to 800 kg/m^3 against water density of 1000kg/m^3 and thus it makes lighter than water and it floats.

The product is also having good compressive strength of around 40 MPa.

The product has many specialties as described below:

1. It is lighter than water, density 700 to 800 kg/m^3. This lighter density makes it float on water.

2. It has plastic reinforcement which makes it durable when kept floating in water.

3. It has a specially developed female and male stainless steel connector which creating path ways, vehicle ways and big platforms for installation like solar panels on water bodies.

4. It would have required buoyancy force and structural strength to meet the above needs as mentioned in point 3.

5. It consists of environment advantages, such as conserving of land resource, reduce CO^2 emission due to use of lower quantity of Ordinary Portland Cement (OPC) and use of environment friendly materials like Ground Granulated Blast Furnace Slag (GGBS).

6. The product has been developed by combination of light weight aggregates creating annular air traps

CLAIMS

1. This unique product Holcim Floatcrete concrete is characterized by the description and abstract indicated shall be having exclusive intelligent property rights for the inventor and anyone trying to utilize this combination directly or indirectly and copying the same would be breaching the patent rights filed for this product by the inventor and the said party would be liable for legal actions.

TITLE OF INVENTION

FLOATABLE CONCRETE AND A METHOD OF FABRICATION THE SAME

BACKGROUND OF THE INVENTION

TECHNICAL FIELD

The subject matter described herein relates to concrete element. In particular, the subject matter described herein relates to concrete which floats on seawater or fresh water, and also relates to the method for forming concrete element.

BACKGROUND OF THE INVENTION

Floatable concrete composed of a concrete surrounding buoyant elements such as foam have long been used in marine or for the construction of floating platform. The concrete is formed with lightweight aggregate. The primary disadvantage of lightweight aggregate concrete is its expensive cost.

Attempts have been made to solve the cost of fabrication by reducing the amount of concrete used. These attempts include the use of foam cores to support the float deck. However, the foam shrinks in size with the passage of time at a far greater rate than the concrete shrinkage so that a void is soon created between the upper surface of the foam and the lower surface of the concrete deck.

US Patent No. 4715307 discloses a method of fabricating a marine float, comprising the steps of : (a) Providing a form having a generally rectangular configuration; (b) Placing a texturing mat in said form; (c) Spraying a layer of glass fiber reinforced concrete into said form over said mat to form a textured deck; (d) Pouring a layer of standard aggregate concrete over said textured deck; (e) Placing a buoyant element of expanded polystyrene foam on said layer of fiberglass reinforced cement; (f) Spraying a layer of fiberglass reinforced cement over the sides and bottom of said buoyant element; (g) Permitting the concrete elements to set; and (h) Removing the form and textured mat.

US Patent No. 4,265,193 discloses a marine float, comprising a concrete shell having a bottom, a deck, two opposed sidewalls having lower edges contacting opposite side edges of said bottom and upper edges contacting opposite side edges of said deck and two opposed endwalls having lower edges contacting respective end edges of said bottom, upper edges contacting respective end edges of said deck, and opposed side edges contacting opposite side edges of said sidewalls, said floats being adapted for joining other of said floats endwall-to-endwall, said deck having a plurality of downwardly projecting transverse and longitudinal reinforcing ribs integrally formed therewith, thereby allowing said deck to have a relatively thin mean thickness, said float further including a tubular conduit extending transversely beneath each transverse rib in contact with the lower edge thereof, and a tie rod extending through each of said conduits with the ends of said tie rods projecting from the sidewalls of said float to allow said tie rods to be secured to fastening members which fasten said floats to each other.

US Patent No. 4318361 discloses a lightweight concrete marine float having the shape of a parallelepiped, comprising a generally rectangular deck plate having a substantially smooth deck surface, said deck plate being formed by standard aggregate concrete having a density greater than the density of water, said float further including side walls, end walls and a bottom plate having interconnected adjoining edges, said side walls, end walls and bottom plate being formed of a lightweight aggregate concrete having a density which is less dense than the density of water, said deck plate, side walls, end walls and bottom plate surrounding a buoyant foam core such that when said float is placed in water, the bottom plate is biased against the underside of said foam core, thereby inherently compressing the side walls and end walls of said float to maximize the strength of said float.

To alleviate the above described problems with concrete floats of standard aggregate concrete, the present floatable concretes have been manufactured of lightweight aggregate concrete with specific properties.

SUMMARY OF THE INVENTION

It is an object of the presently disclosed subject matter to provide a novel fabrication method for floatable concrete and new floatable concrete assembly.

It is an object of the present invention to provide a lightweight floatable concrete, comprising: a base layer having a thickness of about 50-80mm thickness formed from concrete; a plurality of lightweight elements positioned on the top of the base layer; and a top surface layer which can either be flat or can be cast with recesses formed thereon, whereby when said floatable concrete is placed in water, the plurality of lightweight elements being of low densities causes the concrete to float.

A further object of the present invention is to provide a method of fabrication a floatable concrete comprising the steps of (i) providing a mould having a desired size and shape configuration for the concrete; (ii) applying a mould release agent onto the internal surface of the mould; (iii) pouring concrete slurry containing coarse aggregates, sand, silica fume and Portland cement and water into the mould to a height of 50-80 mm and leveling the surface of the concrete; (iv) placing a lightweight elements element on top of the concrete in step (i) within the mould; and (v) pouring concrete to cover and surround the lightweight elements and the surface of the concrete being design to adapt to specific utility of the concrete;(vi) allowing the concrete to set for 48 hours; and (vii) de-moulding the mould of the concrete to obtain a lightweight floatable concrete.

Yet a further object of the present invention is to provide a lightweight floatable concrete, wherein the lightweight elements are selected form the group consisting of PVC pipes with sealed ends and Polystyrene sheets, and the shape of the cast concrete is square, rectangular, triangular, or circular or the combination thereof.

Still a further object of the present invention is to provide a lightweight floatable concrete, wherein the centre of gravity of the base layer is in the same plane as the centre of buoyancy and are placed nearer to the bottom of the floatable concrete. Welded chicken mesh is incorporated along the bottom cover of the concrete to provide flexural strength to the lightweight elements.

Yet another object of the present invention is to provide a lightweight floatable concrete, wherein the reserve buoyancies are between 50 to 130 kg per square meter and the density of the concrete is less than 2000 kg/m3 in dry.

Yet still another object of the present invention to provide a method of fabrication a floatable concrete, wherein the aggregate impact value (AIV) of the aggregate varies from 15- 40%, and have cellular segmented pore structure with solid volume varying between 40 and 70%.

Another object of the present invention is to provide a lightweight coarse aggregates having cellular segmented pore structure with solid volume varying between 40 and 70% for use in the fabrication of floatable concrete comprising (i) natural sand varying between 650 to 700 kg/m^3; (ii) a small quantity of washed copper slag; (iii) Portland cement varying between 500 and 650 kg/m^3; (iv) densified silica fume varying between 50-60 kg/m^3; (v) water to binder ration being maintained around 0.30-0.40 to achieve an initial slump of 100+/-20 mm; and (vi) a Sulphonated Napthalene Formaldehyde (SNF) based superplasticizer being added in an amount 1200-1400ml/100 kg of Portland cement. The air content is maintained between 8% - 10% by adding an air entraining agent.

A further object of the present invention is to provide a method of fabrication a floatable concrete, wherein the concrete contains coarse aggregate which varies from 250-350 kg/m^3 of the concrete and the natural sand varying between 650-700 kg/m^3, and contains Portland cement varying between 500-650 kg/m^3 and densified silica fume varying between 50 - 60kg/m^3.

Yet a further object of the present invention is to provide a floatable concrete, wherein the floatable concrete is used for enhancing Urban Greenery, which provides a means to grow plant while the plants do not require regular watering as the bottom recess of the floatable concrete has the access to the water for their normal growth and survival.

Still a further object of the present invention is to provide a floatable concrete, wherein the concrete is mounted with a suitably built-in connecting system so that a plurality of individual floatable concretes can be joined to form a chain of floatable concrete assembly.

Yet a further object of the present invention is to provide a floatable concrete, wherein rubber fenders are fixed around the floatable concrete to enhance collision resistant.

An object of the presently disclosed subject matter having been stated herein above, and which is achieved in whole or in part by the presently disclosed subject matter, other objects will become evident as the description proceeds when taken in connection with the accompanying drawings as best described hereinbelow.

BRIEF DESCRIPTION OF THE DRAWINGS

The subject matter described herein will now be explained with reference to the accompanying drawings of which:

FIG. 1 is a perspective view showing the fabrication of the floatable concrete in accordance with an embodiment of the present invention;

FIG. 2 is a section view of the floatable concrete in accordance with an embodiment of the present invention;

FIG. 3 is an elevation view of the floatable concrete in accordance with an embodiment of the disclosed subject matter;

FIG. 4 is a top view of a floatable concrete in accordance with an embodiment of the present invention;

FIG. 5 is a perspective view of a floatable concrete, wherein the top layer of the floatable concrete is provided with a plurality of recesses for potted plant in accordance with the present invention.

FIG. 6 is a perspective view showing the floatable concrete being able to join with another one in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Method of fabrication lightweight concrete structure and the concrete thereof is disclosed herein.

FIG. 6 illustrates a perspective view of an exemplary lightweight concrete, generally designated 300, in accordance with an embodiment of the present invention disclosed herein. FIG. 1 shows a perspective view of a concrete mould 100 which is a framework to form a rectangular shape floatable concrete. A plurality of hollow PVC tubes with sealed caps are positioned within the center of the moulding after a base layer concrete 110 is formed within the moulding 100.

In accordance with the preferred embodiment of the present invention, the lightweight floatable concrete comprises: a base layer concrete 110 having a thickness of about 50-80mm thickness formed from concrete; a plurality of lightweight elements 200 centrally positioned on the top of the base layer concrete 110; and a top surface layer 200 which can either be flat or can be cast with recesses 230 (FIG. 5) formed thereon, whereby the floatable concrete is afloat on water for the reason that the plurality of lightweight elements 200 being of low densities than water, and thereby the concrete is stably afloat on water surface.

The present invention also related to a method of fabrication a floatable concrete comprising the steps of (i) providing a mould 100 having a desired size and shape configuration for the concrete; (ii) applying a mould release agent onto the internal surface of the mould 100; (iii) pouring concrete slurry containing coarse aggregates, sand, silica fume and Portland cement and water into the mould 100 to a height of 50-80 mm and leveling the surface of the concrete; (iv) placing a plurality of lightweight elements on top of the concrete in step (i) within the mould 100; and (v) pouring concrete to cover and surround the lightweight elements 200 and the surface of the concrete being designed to adapt to specific utility of the concrete;(vi) allowing the concrete to set for 48 hours; and (vii) de-moulding the mould 100 of the concrete to obtain a lightweight floatable concrete. Referring to FIG. 1, there is shown there the mould 100 is made from wooden block and the lightweight elements are hollow PVC tubes with caps and the end thereof. A base layer 110 (not shown in FIG. 1) is beneath the plurality of the lightweight elements 100 and concrete is then formed on top of the lightweight elements 200.

In the present invention, the lightweight elements 200 can be selected from the group consisting of PVC pipes with sealed ends and polystyrene sheets. The size and the properties of the lightweight

elements are selected in such a way that the material achieves sufficient amount of draft to avoid tilting of the lightweight elements after the concrete is made to float. In accordance with the present invention, the shape of the cast concrete can be square, rectangular, triangular, or circular or the combination thereof. The shape of the floatable concrete is largely dependent on the needs, such as for planting plants, creepers with the roots having direct access to the water for their normal growth and survival. In the course of positioning the lightweight elements, they have to be placed in such a way that the centre of gravity is near the base of the floatcrete and is in the same plane as the centre of the buoyancy. The lightweight elements are placed in a symmetrically in the body of the floatable concrete and are cast into the floatable concrete to get a monolithic element. Comparatively the base layer 110 is relatively large to ensure that the Centre of Gravity of the floatable concrete is located closer towards the base of the concrete. At this instance, the Centre of buoyance and the centre of Gravity are in the same plane. In order to increase the flexural strength to the buoyance element, welded chicken mesh is incorporated along the base layer 110 of the concrete. In the present preferred embodiment, the reserve buoyancy of the concrete is between 50 to 130 kg per square meter of the projected area, and the top surface of the concrete 200 can be either flat or be cast to form recess for placing potted plants. FIG. 5 is a perspective view showing the top surface of the floatable concrete being cast to from a plurality of recesses 230. In the present invention, the lightweight concrete is made by using expanded shale/clay coarse aggregates, and the aggregate impact value (AIV) of the aggregate varies from 15- 40%. The aggregates have cellular segmented pore structure with solid volume varying between 40 and 70%.

In the fabrication method as described above, the concrete contains coarse aggregate which varies from 250-350 kg/m3 of the concrete, natural sand varying between 650-700 kg/m3, and Portland cement varying between 500-650 kg/m3 and densified silica fume varying between 50 - 60kg/m3.

The present invention also relates to a lightweight coarse aggregates having cellular segmented pore structure with solid volume for use in the fabrication of floatable concrete comprising (i) natural sand varying between 650 to 700 kg/m^3; (ii) a small quantity of washed copper slag; (iii) Portland cement varying between 500 and 650 kg/m^3; (iv) densified silica fume varying between 50-60 kg/m^3; (v) water to binder ratio being maintained around 0.30-0.40 to achieve an initial slump of 100+/-20 mm; and (vi) a Sulphonated Napthalene Formaldehyde (SNF) based superplasticizer being added in an amount 1200-1400ml/100 kg of Portland cement. Air content is maintained between 8-10% by adding an air entraining agent to the mix. In the preferred embodiment for the fabrication of the floatable concrete, the concrete has a characteristic strength of 15MPa to 45MPa, and the unit weight of the concrete is less than 2000 kg/m^3 and the static modulus of elasticity varies from 18 to 25 GPa. The 28-day drying shrinkage of the cement is less than 400 micro-strains. In the fabrication process, the coarse aggregates are pre-wetted by sprinkling water.

In another preferred embodiment of the present invention, the lightweight floatable concrete further comprising built-in connecting system for joining each of the concrete to form a chain of concrete, as shown in FIG. 6. The floatable concrete can also further include rubber fenders fixed around the concrete to provide collision resistant.

FIG. 2 is a section view of the floatable concrete in accordance with an embodiment of the present invention; FIG. 3 is an elevation view of the floatable concrete in accordance with an embodiment of

the disclosed subject matter; and FIG. 4 is a top view of a floatable concrete in accordance with an embodiment of the present invention.

In accordance with the present invention, the floatable concrete, is designed to ensure no imbalance in the structure as a result of uneven concrete cover thickness on all the sides. A plurality of plastic or mortar spacers are used while casting to form uniform cover thickness. The size and dimensions of the lightweight elements are selected to achieve sufficient amount of Draft to avoid tilting after the floatable concrete is made to float. As mentioned above, in order to attain the required Reserve Buoyancy, lightweight elements is selected from PVC pipes with sealed ends, or Polystyrene Sheets are used and are placed in a symmetrically in the body of the floatable concrete, and are cast into the floatable concrete to get a monolithic element. The base layer or the cover of the bottom of the concrete is kept relatively large (about 50 to 75 mm thick) to ensure that the Centre of Gravity of the concrete is located closer towards the base thereof. The Centre of Buoyance and the Centre of Gravity of the element are placed in the same plane.

Working Example: Casting The Floatable Concrete

The floatable concrete is cast with concrete of various grades and densities which are essentially classified as lightweight concrete (Oven dry density less than 2000 kg per cubic meter).

The lightweight concrete was made by using expanded shale / clay coarse aggregates (5 – 15 mm size, or 10 – 23 mm size, specific gravity (SG):1.30 or 0.6). The Average Impact Value (AIV) of the aggregate varied from 16 to 37% depending up on the physical condition of the aggregate (Saturated Surface Dry Condition (SSD)/oven dry). The aggregates had a cellular segmented pore structure with solid volume varying between 40 and 70%. The amount of coarse aggregate in the mix varied from 250 to 350 kg per cubic meter of concrete with balance consisting of natural sand (2.6 SG, Fineness Modulus (FM) 2.6 to 2.9) varying between 650 and 700 kg/m^3. Addition of small quantity of washed copper slag (WCS) as a replacement to sand to the mix would decrease the thermal conductivity (k) but increase the unit weight / oven day density of the concrete. The cementitious materials were Portland cement conforming to CEM I (52.5 N Grade) varying between 500 and 650 kg/m3 and un-densified silica fume varying between 50 and 60 kg/m^3. The water / binder ratio was maintained around 0.30 to 0.40 to achieve an initial slump of 100 +/- 20 mm. A Sulphonated Napthalene Formaldehyde (SNF) based superplasticizer was added (1200 - 1400 ml / 100 kg cementitious material) to achieve the desired consistency. An air entraining agent was also added (300 ml / 100 kg cementitious materials) to achieve an air content of 8 - 10%. The compressive strength increased with decreasing air content in the mix. A set retarder was added to adjust the stiffening time of the concrete.

The concrete used for the floatable concrete was lightweight concrete having a characteristic strength of 15 MPa to 45 MPa. The unit weight of the concrete was less than 2000 kg/m^3. On drying the cube in the oven the density would drop by 4 - 8% from the wet density. The Static Modulus of Elasticity varies from 18 to 25 GPa depending on the grades of the concrete. The 28-day drying shrinkage was less than 400 micro-strains.

Working Example: Mixing And Placement Of Concrete

The lightweight coarse aggregates were pre-wetted before the aggregates were batched by sprinkling water and were brought to Saturated Surface Dry (SSD) condition at the time of batching. The coarse aggregates, sand and silica fume were first discharged into the mixer and mixed followed by Portland cement and water. The admixtures were added to the mix through the last portion of the mix water. The total mixing time varied between 40 and 60 seconds to achieve a mix having uniform consistency. A sample of concrete discharged from the truck mixer (second discharge) was collected in a wheel barrow and tested for consistency through slump cone test.

In the preferred embodiment of the present invention, a wooden mould 100 was prepared with dimension conforming to the design of the floatable concrete. At this instance, a rectangular shape floatable concrete was fabricated. A suitable mould release agent was applied onto all the internal surfaces prior to pouring the concrete into the mould 100. Compaction of the concrete in the mould 100 was done by rodding and the base layer 100 concrete was compacted uniformly to avoid local variations in the density of the concrete. Vibration on the mould 100 must be avoided to ensure cohesiveness of the mix. For those lightweight concrete made with lightweight aggregate having specific gravity (SG) less than 1 vibration during placement must be avoided.

The de-moulding was done 48 hours after the casting and the floatable concrete resting on plywood would be transported to the water tank and prepared to be pushed slowly into the tank.

It will be understood that various details of the presently disclosed subject matter may be changed without departing from the scope of the presently disclosed subject matter. Furthermore, the foregoing description is for the purpose of illustration only, and not for the purpose of limitation.

CLAIMS

1. A lightweight floatable concrete, comprising:
a base layer having a thickness of about 50-80mm thickness formed from concrete;
a plurality of lightweight elements positioned on the top of the base layer; and
a top surface layer which can either be flat or can be cast with recesses formed thereon, whereby when said floatable concrete is placed in water, the plurality of lightweight elements being of low densities causes the concrete to float.
2. The lightweight floatable concrete of Claim 1, the lightweight elements are selected form the group consisting of PVC pipes with sealed ends and Polystyrene sheets.
3. The lightweight floatable concrete of Claim 1, wherein the shape of the cast concrete is square, rectangular, triangular, or circular or the combination thereof.
4. The lightweight floatable concrete of Claim 1, wherein the centre of gravity and the center of buoyancy are in the same plane.
5. The lightweight floatable concrete of Claim 1, wherein welded chicken mesh is incorporated along the bottom cover of the concrete to provide flexural strength to the lightweight elements.
6. The lightweight floatable concrete of Claim 1, wherein the reserve buoyancy of the lightweight elements is between 50 to 130 kg per square meter.
7. The lightweight floatable concrete of Claim 1, wherein the density of the concrete is less than 2000 kg/m^3 in dry.
8. A method of fabrication a floatable concrete comprising the steps of (i) providing a mould having a desired size and shape configuration for the concrete; (ii) applying a mould release agent onto the internal surface of the mould; (iii) pouring concrete slurry containing coarse aggregates, sand, silica fume and Portland cement and water into the mould to a height of 50-80 mm and leveling the surface of the concrete; (iv) placing a plurality of lightweight elements on top of the concrete in step (i) within the mould; and (v) pouring concrete to cover and surround the lightweight elements and the surface of the concrete being designed to adapt to specific utility of the concrete;(vi) allowing the concrete to set for 48 hours; and (vii) de-moulding the mould of the concrete to obtain a lightweight floatable concrete.
9. The method of fabrication a floatable concrete of Claim 8, wherein the lightweight concrete is made by using expanded shale/clay coarse aggregates.
10. The method of fabrication a floatable concrete of Claim 9, wherein the aggregate impact value (AIV) of the aggregate varies from 15- 40%.
11. The method of fabrication a floatable concrete of Claim 8, wherein the aggregates have cellular segmented pore structure with solid volume varying between 40 and 70%.
12. The method of fabrication a floatable concrete of Claim 8, wherein the concrete contains coarse aggregate which varies from 250-350 kg/m^3 of the concrete.
13. The method of fabrication a floatable concrete of Claim 8, wherein the concrete contains natural sand varying between 650-700 kg/m^3.
14. The method of fabrication a floatable concrete of Claim 8, wherein the concrete contains Portland cement varying between 500-650 kg/m^3 and un-densified silica fume varying between 50 - 60kg/m^3.
15. A lightweight coarse aggregates having cellular segmented pore structure having solid volume (40-70%) for use in the fabrication of floatable concrete comprising (i) natural sand

varying between 650 to 700 kg/m^3; (ii) a small quantity of washed copper slag; (iii) Portland cement varying between 500 and 650 kg/m^3; (iv) densified silica fume varying between 50-60 kg/m^3; (v) water to binder ratio being maintained around 0.30-0.40 to achieve an initial slump of 100+/-20 mm; and (vi) a Sulphonated Napthalene Formaldehyde (SNF) based superplasticizer being added in an amount 1200-1400ml/100 kg of Portland cement; (vii) and an entraining agent being added to achieve an air content of 8-10%.

16. The method of fabrication a floatable concrete of Claim 8, wherein the concrete has a characteristic strength of 15MPa to 45MPa.
17. The method of fabrication of a floatable concrete of Claim 8, wherein the unit weight of the concrete is less than 2000 kg/m^3 and the static modulus of elasticity varies from 18 to 25 GPa.
18. The method of fabrication of a floatable concrete of Claim 8, wherein the 28-day drying shrinkage of the cement is less than 400 micro-strains.
19. The method of fabrication of a floatable concrete of Claim 8, wherein the centre of gravity and the center of the buoyance of lightweight elements are in the same plane.
20. The method of fabrication of a floatable concrete of Claim 8 or Claim 15, wherein the coarse aggregates are pre-wetted by sprinkling water.
21. The method of fabrication of a floatable concrete of Claim 8, wherein the mould is configured to allow the lightweight elements to be secured symmetrically therein.
22. The method of fabrication of a floatable concrete of Claim 8, wherein the buoyant element is selected from the group consisting of expanded polystyrene sheets and PVC pipes with sealed ends.
23. The lightweight floatable concrete of Claim 1, further comprising built-in connecting system for joining each of the concrete to form a chain of concrete.
24. The lightweight floatable concrete of Claim 1, further comprising rubber fenders fixed around the concrete to provide collision resistant.
25. A lightweight floatable concrete, comprising: a base layer having a thickness of about 50-80mm thickness formed from concrete; a plurality of PVC pipes with sealed ends positioned on the top of the base layer; and a top surface layer which can either be flat or can be cast with recesses formed thereon, and the center of gravity of the base layer and the center of the PVC pipes is in the same plane, whereby when said floatable concrete is placed in water, the plurality of lightweight elements being of low densities causes the concrete to float.