ECOLOGICALLY FRIENDLY SANDLESS MORTAR SYSTEM

Field of the Invention

The present invention relates generally to a lightweight concrete and a method for making the same.

Background of the Invention

Lightweight concretes such as aerated or foamed concretes can be used for walls, ceilings, floors and roofs for building structures. The concrete can be produced with a wide range of densities, choice of aggregates and mixtures.

Conventionally, a lightweight concrete is made by mixing a cement mixture with a foaming agent. The foaming agent will develop air pockets or bubbles in the mixture causing the mixture to expand. After the mixture expands, the concrete is allowed to set leaving concrete with plenty of voids. The presence of the voids provides a light weight mortar with limited compressive strength.

The components in a cement mixture include cement (i.e. typically Portland cement), aggregates, fillers and water. Typically, fine aggregates such as silica sands are used. The water reacts with the cement, which bonds the other components of the concrete together.

During mixing and curing process of the lightweight concrete, the mixture is subjected to friction due to the movement and segregation of the components, which may cause some bubbles to collapse (hence giving variable density drift specially in high vertical wall infill). This will affect the final volume of the concrete and contribute weak point in the structure after the concrete is cured or settle. This problem will become more apparent when a higher volume of concrete is used and the concrete takes a longer time to cure or settle.

In view of the above limitation and problem, the present invention attempts to provide a lightweight concrete with enhanced strength and improved characteristics so that it can be used in many construction applications that is not limited to light building construction. The method for making the lightweight concrete attempts to alleviate the problem of collapsed bubbles, enhance bonding strength between the concrete components and improve the compressive strength of the concrete.

Summary of the Invention

A lightweight concrete according to the present invention has a composition comprising cement or other cementitous material, a foaming agent, a hydrogen-silicon compound and a polymer compound.

The use of hydrogen-silicon and polymer compounds in the concrete mixture will improve the characteristics and properties of the concrete. When these compounds are added to a concrete mixture, the mixing and bonding between the components will increase inside the mixture, the consistency, workability and pumpability of the concrete will improve. Thus, making the concrete easy to flow and spread.

The use of hydrogen-silicon and polymer compounds in the concrete mixture will also improve improved moisture resistance, temperature resistance and chemical resistance. Building materials such as floors and walls made from this concrete will have improved fire retardant properties.

Hydrogen silicon and polymer compounds in the concrete mixture will improve the strength of the concrete. These compounds increase matrix strength of the concrete by creating crosslinking between the components. This will give a better load to weight ratio compared to conventional lightweight concrete.

According to the present invention, the hydrogen-silicon compound acts as adhesive promoter, coupling agent and crosslinking agent.

In the crosslinking process, the hydrogen-silicon compound is first mixed with the polymer compound. Then, water with suitable catalysts is introduced into the mixture through hydrolysis and condensation reaction.

The mixture of hydrogen-silicon compound and the polymer compound is then combined to cement mixture, which is blended separately. Foaming agent is added to the mixture of hydrogen-silicon and polymer compounds before the mixture is combined to the cement mixture so that more bubbles are obtainable. In this way, the problem of collapsed bubble can be overcome.

Brief Description of the Drawing

The present invention will be described further by way of example only, with reference to the accompanying drawing.

Fig. 1 shows a diagram for preparing a lightweight concrete according to the present invention.

Detailed Description of the Invention

A lightweight concrete according to the present invention is prepared by incorporating silane into the aerated or foamed concrete mixture. Silane can be in any form of hydrogen-silicon compounds or silicon hydrate such as disilane with chemical formula of Si_2H_6, trisilane with chemical formula of Si_3H_8, and monosilane with chemical formula of SiH_4. The silane contains a central silicon (Si) atom bonded to two types of groups: Alkoxy groups and organofunctional groups. The organofunctional groups react with various polymers.

The use of hydrogen-silicon and polymer compounds in the concrete mixture will improve the characteristics and properties of the concrete. When these compounds are added to a concrete mixture, the mixing and bonding of the components inside the

mixture, consistency, workability and pumpabilty of the concrete will improve. Thus, increasing the pumpability of concrete. The concrete will flow with ease and spread evenly with integrity. In construction work, for example, concrete that is prepared at a lower ground can be easily pumped or channel to a higher floor or vice versa. This concrete allows floors of a building to be constructed with ease and minimize the construction loading without sacrificing the required floor strength. The improved pumpability of the concrete is suitable for underground construction works.

The use of silane in the concrete mixture allows the concrete to bond with many types of substrates, surfaces and fillers. Example of fillers are silica, aluminum, alumina, aluminosilicae, mica, talc, iron asbestos, nickel, zine, lead, calcium carbonate and calcium sulfate. These include concrete, glass, metal and any suitable minerals.

According to the present invention, by incorporating the silane, a cement mixture can be prepared without fillers. For instance, the use of fillers such as silica sand is not required in the cement mixture. As silane bonds to various polymers in which the polymers will also bond with the substrates, surfaces and fillers. This multiple bonding actions will enhance the bonding of the concrete with any suitable surfaces and materials.

In the concrete mixture, silane acts as adhesive promoter, coupling agent and crosslinking agent. In the crosslinking process, the silane is first grafted into the polymer. Then, the silane-grafted polymer is introduced with water together with suitable catalyst and then through condensation of silanol. By activating the organo-functional group with hydrolysable group, a strong bond of Si-O-Si is formed between the silane hydrolysable group at one end and cement matrix and the other end and cross linkage of hydrolysable group with polymer also present which hold up the polymer thus the polymer no longer act alone to bond the substrate or filler. The whole system now acts as a matrix linkage of all polymer since the polymer is a able contribute adhesion and a multi layer bonding strength comprise of cement bonding, polymer cross link to polymer form a sheet to bond to substrate with one end silane

active si-0-si bond and finally the other end of polymer bond strength. These three type of bonding highly improve the compressive strength

The use of a hydrogen silicon compound together with a polymer compound has increased the strength of the lightweight concrete compared to conventional lightweight concrete. This will give a better load to weight ratio compared to conventional lightweight concrete.

The use of hydrogen-silicon and polymer compounds in the concrete mixture will improve improved moisture resistance, temperature resistance and chemical resistance. Building materials such as floors and walls made from this concrete will have improved fire retardant properties.

In another embodiment, mineral admixtures are added to the concrete mixture to make the concrete fire retardant. In an example, alumina material such as alumina trihydrate (ATH) is incorporated to the concrete mixture so that the concrete has the ability to release water or moisture when it receives heat.

To prepare the concrete mixture, separate mixtures are first prepared. The mixtures are combined together. As shown in Figure 1, components in Part A and Part B are blended separately and combined together in a mixing chamber before the concrete can be used.

Part A

Firstly, a hydrogen-silicon compound is mixed with a polymer compound for creating a first mixture. The polymer compound can be in the form liquid or powder such as carboxylated stryrene butadiene copolymer, stryrene acrylic, acrylic and copolymer powder of vinyl acetate. Secondly, the first mixture is reacted with water in hydrolysis and condensation processes. Then, a viscosity modifier is added to improve the rheology effect, which helps to maintain the cohesiveness when the mixture is

pumped. The mixture prepared in Part A is then combined with cement mixture in Part B.

Part B

A cement mixture is provided by mixing a Portland cement and/or other cementitous materials and fillers with water. The fillers can be in the form of light weight materials such as wood chips or mineral such as silica or other suitable minerals. The cement mixture can also be prepared with or without fillers. Water reducer agent such as polycarboxylate ether is added into the cement mixture for water reduction. Other additive such as biocide or viscosity adjustment agent also can be added to the cement mixture.

Mixing Part A and Part B

The mixtures in Part A and Part B are combined together in a first mixing chamber (105). The mixtures are then transferred to a second mixing chamber (107) where a foaming agent is added to create bubbles or air pockets before it can be discharged or pumped into a job site as free-flowing concrete or cast as concrete blocks or slabs or used for process of extrusion method to produce lightweight bricks. The use of hydrogen-silicon compound together with the addition of foaming agent in the last stage of the mixing process prevent the bubbles to collapse.

Claims

1. A lightweight concrete having a composition comprising
   a cement mixture;
   a foaming agent; and
   a hydrogen-silicon compound together with a polymer compound for improving pumpability, strength, and bonding properties of the concrete.

2. A lightweight concrete as claimed in claim 1 wherein the cement mixture includes cement and water.

3. A lightweight concrete as claimed in claim 2 wherein the cement mixture further includes filler such as silica, aluminum, alumina, aluminosilicae, mica, talc, iron asbestos, nickel, zine, lead, calcium carbonate and calcium sulfate.

4. A lightweight concrete as claimed in claims 1, 2 or 3 wherein the concrete is fire retardant.

5. A lightweight concrete as claimed in claim 4 wherein the concrete includes alumina material such as alumina trihydrate (ATH) for making the concrete to release water when heated.

6. A lightweight concrete as claimed in claim 1 wherein the hydrogen-silicon compound is silane.

7. A lightweight concrete as claimed in claim 1 wherein the improved pumpability allows the concrete to flow with ease with integrity

8. A lightweight concrete as claimed in claim 1 wherein the pumpability of the concrete allows floors of a building to be constructed with ease and minimize the construction loading without sacrificing the floor strength.

9. A method of making a lightweight concrete comprising the steps of:

mixing a hydrogen-silicon compound with a polymer compound for creating a first mixture;
introducing water into the mixture for hydrolysis and condensation for creating a second mixture;
combining the second mixture with a cement mixture for creating a third mixture;
introducing a foaming agent into the third mixture

10. A method of making a lightweight concrete as claimed in claim 9 wherein the cement mixture includes cement and water.

11. A method of making a lightweight concrete as claimed in claim 9 wherein the cement mixture further includes filler such as silica, aluminum, alumina, aluminosilicae, mica, talc, iron asbestos, nickel, zine, lead, calcium carbonate and calcium sulfate.

12. A method of making a lightweight concrete as claimed in claim 9 wherein a viscosity modifier is added to the first mixture.

13. A method of making a lightweight concrete as claimed in claim 9 wherein the composition further comprise alumina material such as alumina trihydrate (ATH) for making the concrete to release water when heated.

14. A method for making a lightweight concrete as claimed in claim 9 wherein the hydrogen-silicon compound is silane.

15. A method for making a lightweight concrete as claimed in claim 14 wherein the silane is gamma-glycidoxypropyltrimethoxysilane.

16. A method for making a lightweight concrete as claimed in claim 9 wherein the second mixture is mixed with a cement mixture in a first mixing chamber.

17. A method for making a lightweight concrete as claimed in claim 9 wherein the third mixture is transferred to a second mixing chamber.

18. A method for making a lightweight concrete as claimed in claim 17 wherein the third mixture receives a foaming agent in the second mixing chamber and mixed as a final concrete mixture.

19. A method for making a lightweight concrete as claimed in claim 18 wherein the concrete mixture is discharged for use.