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(54) Title: COMPOSITIONS FOR PRODUCTION OF LIGHTWEIGHT CONSTRUCTION ELEMENTS AND COLORED LIGHTWEIGHT CONSTRUCTION ELEMENTS AND METHODS FOR PRODUCTION OF THE SAME

(57) Abstract: The present invention relates to a composition and a production method provided to enable the production of the lightweight construction elements and the colored lightweight construction elements commonly used in the construction sector, with improved technical properties and in an economical manner. The composition provided according to the present invention comprises clay or the mixture of clay/quartz or expanded quartz as the binder agent; expanded perlite as the main fill material; coal, shavings or styrofoam powder as the intermediate fill material; tincal, ulexite or albite as the additive and optionally the pigments for coloring purposes. As a result, the strong lightweight construction elements and colored lightweight construction elements are obtained with the characteristics of being economical, and having low density and low heat conduction properties.

COMPOSITIONS FOR PRODUCTION OF LIGHTWEIGHT CONSTRUCTION ELEMENTS AND COLORED LIGHTWEIGHT CONSTRUCTION ELEMENTS AND METHODS FOR PRODUCTION OF THE SAME

Technical field of the invention

The present invention relates to a novel composition, which enables the production of the construction materials (brick, kerb, hollow block, tile, etc.) commonly used in the construction works of the construction sector, such as the walls, floors and pavements, in desired color and color shade and in such a way that said materials will have sufficient strength.

Prior Art

As is commonly known, the high heat permeability and the high weight per unit volume of the currently present construction elements, which have been produced for a long time, are the main problems undesirable for both the producers and the consumers.

Until the present, the construction materials such as the brick have been typically produced by shaping and kiln-drying at a temperature above 1000°C the compositions comprised of the materials such as clay, coal dust, shavings, polystyrene and sometimes fireclay. Further, the construction elements having various compositions and production techniques have been also described in the state of the art.

The composition described in the patent document no. GB 2108977 basically comprises, in order to produce a construction with a low water and heat permeability, SiO_2, Al_2O_3, B_2O_3, CaO + MgO and Na_2O, and the final product is obtained by firing said composition at 600-700°C. Said oxidic compounds are obtained from the liquid-solid mixture of sodium silicate, borax and perlite.

The patent document no. GB 2084624 discloses a construction element with fire resistance and high heat isolation properties. The composition constituting said construction element basically comprises expanded perlite, clay, fibre, B_2O_2 and the materials that provide water impermeability.

US patent no. US 4,462,835 discloses a lightweight construction element and a method for the production of the same. The composition used in the production of said construction element generally comprises expanded perlite, water glass, water, hardener and the air bubble-forming components.

The patent document no. WO 02/36522 describes a construction element whose chemical composition consists of perlite, pumice or pumice-derived substances as well as the additives of Na_2O and B_2O_3. However, since the composition presented in this patent document has a perlite content in excess of 90%, it will be subject to a high extent of volume increase and consequently, a loss of strength that is not negligible.

When said patent documents and the state of the art are considered, the use of the materials like clay, expanded perlite and boron oxide is known in the compositions for the production of various construction elements, but it is not possible to present a composition with synergistic effect for the reduction of the weight per unit volume of the construction elements and the production of the construction elements with desired color and color shade, and a method for the production of the same. Since the boron derivatives used are generally contemplated as the fill material and/or binder agent, the materials that are not rich in electrons have been used. The present invention solves the mentioned technical problems by means of the compositions described below and the production methods for the same. Each component present in the composition enables to achieve the objects of the invention, by exhibiting synergistic effect with the others. As a result, a construction element is provided, which is light in weight and advantageous from the standpoint of decoration. Low sound permeability and the high resistance to water, moisture and corrosion may be indicated as the side features provided by the present invention.

Objects of the Invention

One of the objects of the invention is to produce the lightweight construction elements with low density per unit volume and sufficient isolation properties by means of a composition formed from the components that are selected in a way to exhibit synergistic effect.

Another object of the present invention is to present the composition used in the production of the lightweight construction elements along with the additives rich in electrons so that the firing temperature may be reduced, and thus to obtain an efficient process from the standpoint of energy.

Another object of the present invention is to provide a method that will eliminate the disadvantages of the lightweight construction elements, such as cracking and crumbling after the production.

Another object of the present invention is to enable the production of said lightweight construction elements in desired colors and color shades.

Brief Description of the Invention

The present invention enables the floors, walls, roofs, pavements and many other components that may be the subject of the construction industry, particularly the wall building elements such as the bricks, to attain a more economic, more convenient and a technically more capable state. Production of said construction elements by using a composition with the contents of binder, additive, main fill material, intermediate fill material and the pigments of the desired colors brings about both the high isolation capabilities and the lightness in weight and the desired colorfulness in a single product.

The binder agent used in the composition presented by the present invention has been determined to be particularly clay or optionally, the mixture of clay/quartz or expended quartz (quartz expands by 40% at a temperature of 800°). Also, the additive used has been determined to be a compound rich in electrons, such as the boron derivatives like tincal and ulexite, or albite. Said compounds with boron and albite content reduce the firing temperature for the composition to provide savings in energy, and they also eliminate the volumetric contraction of the other materials present in the composition as a result of the high temperature so that the desired porous structure may be obtained. The preferred boron-containing compounds are determined to be tincal and ulexite which are rich in electrons. The porous structure present in the expanded perlite selected as the main fill material is surrounded by the additives, which are the derivatives of boron and albite, and the binder agent of clay,

hence the air is entrapped within the pores such that the material attains significantly high isolation features, in other words, a low heat conduction coefficient. The coal, shavings and the styrofoam powders preferred as the intermediate fill material have a higher mechanical strength as compared to the expanded perlite, therefore they resist the volume contractions taking place during the production to enable the product to be obtained with desired size and properties. They also aid in the internal firing of the material owing to the combustion reaction taking place during the firing process, and they also help a higher amount of space to remain in the material owing to the reduction in their volume as a result of combustion.

Detailed Description of the Invention

The present invention relates to a novel composition formed to obtain the construction elements with high isolation and strength as well as a low unit weight, and to a method for the production said lightweight construction elements and colored lightweight construction elements by the use of this composition.

As an example of the problems that exist in the above-mentioned state of the art, the disadvantages of the wall building elements like the brick commonly used in the construction sector and produced according to the known methods may be mentioned. Said wall building elements have many disadvantages resulting from their weights per unit volume and their isolation properties. That they have a quite high weight per unit volume leads to an increased building self-weight as well as rendering the transport operations more difficult. Considering also the energy losses caused by their poor isolation properties, it is clearly visible that said materials comprise a great disadvantage for the construction sector and the consumer society.

The composition and the method for the production of the materials like brick and the similar provided by the presented invention eliminate the aforesaid handicaps to a significant extent and bring about many advantages. A classical isolation brick with vertical holes has a unit density of 1600 kg/m^3, a volume density (without space) of 700 kg/m^3 and a heat conduction coefficient of about 0.18 W/mK. On the other hand, the construction elements produced with the composition and the method provided according to the present invention have a reduced unit density of 1000 kg/mK, a volume density of 500 kg/m^3 and a heat conduction coefficient of about 0.8 W/mK.

Also, as will be appreciated by a person skilled in the state of the art upon the consideration of said values, the load of the walls comprised by the wall building elements is reduced by an extent of about 50%, thus a considerable advantage is obtained in case of the events likely to threaten the existence of the buildings, such as an earthquake, owing to the reduction in the total load.

Another advantage of the present invention is that the formed construction element has a high thermal inertia, in other words, the temperature changes in the external environment is transmitted to the interior after being retarded and dampened.

The composition provided according to the present invention basically consists of the binder agent, additives, main fill material, intermediate fill material and optionally, various pigments. Since it is among the objects of the present invention to produce the aforesaid construction elements with desired color and the color shade, in case it is desired, the coloring process may be carried out by means of the method provided according to the invention. Two basic composition types have been determined using said components, and the components and their proportion in said composition types are provided below.

First composition type comprises the following:

- Clay as the binder agent, at a proportion of 30-70%, preferably 40-55% by volume,
- expanded perlite as the main fill material, at a proportion of 10-80%, preferably 30-70% by volume,
- coal, shavings or styrofoam powder as the intermediate fill material, at a proportion of 0.5-20%, preferably 5-15% by volume,
- tincal, ulexite or albite as the additive, at a proportion of 0.1-8%, preferably 0.5-5% by volume.

The desired lightweight construction element is obtained by bringing said composition to the suitable form and firing the same. The method followed during the production is extremely important in obtaining the finished product with the desired physical properties. Accordingly, the binder agent of clay, the additive of tincal, ulexite and/or albite and the intermediate fill material of coal, shavings or styrofoam powder are

mixed in a homogeneous manner. In a separate compartment, the expanded perlite is impregnated with water and this is blended with said homogeneous mixture. The composition thus formed is shaped in the machines, dried, and then fired at a furnace temperature of about 1000°C to yield the finished product in the form of a lightweight and strong brick with low heat conductivity.

In the present procedure, the application of the wetting process by way of impregnation of the expanded perlite with water is of vital importance from the standpoint of the quality of the finished product. The reason is that the homogeneous mixing of the expanded perlite with the other components in the composition is directly related to the amount of moisture it bears, and that owing to said water impregnation process, a homogeneous mixture is obtained in the composition, and thus the cracks and the surface defects likely to form on the finished product are avoided.

Another composition includes the components that enable the production of the construction elements with the various colors. Accordingly, said composition comprises the following components:

- As the binder agent, clay at a proportion of 1-20%, preferably 4-15% by volume, and quartz or expanded quartz at a proportion of 20-40%, preferably 35-45% by volume,
- expanded perlite as the main fill material, at a proportion of 40-80%, preferably 50-70% by volume,
- as the additive, the boron derivatives, preferably tincal and/or ulexite, at a proportion of 0.1-20%, preferably 1-10% by volume, or albite at the same proportion,
- the suitable amount of pigment according to the desired color quality.

The colored lightweight construction elements produced with this composition are extremely suitable for the decorative applications. For the production method, in a manner similar to the previous composition, the binder agent of clay and quartz or expanded quartz, the additive of tincal, ulexite or albite and the dyestuff of pigments are mixed in a homogeneous manner. In a separate compartment, the expanded

perlite is impregnated with water and it is blended with said homogeneous mixture. The composition thus formed is shaped in the machines, dried and fired at a furnace temperature of about 1000°C, to obtain the finished product, that is the colored lightweight construction element. The weight per unit volume and the strength of said material may be adjusted according to the purpose of use.

Each of the components used in the production procedures described above and the amount of each component in the composition have different functions in obtaining the desired product quality. Clay and/or quartz or expanded quartz that are preferred as the binder agents, and the boron derivatives like tincal and ulexite or a compound such as albite that are envisaged as the additive surround the gaps formed in the structure of the expanded perlite, thereby causing the air to be entrapped in these sections. This phenomenon is extremely important for reducing the heat conduction coefficient to the desired values. Since the compounds such as tincal ($Na_2O.2B_2O_3.10H_2O$), ulexite ($NaCaB_5O_9 \cdot 8H_2O$) and albite ($NaAlSi_3O_8$) are rich sources of electron for the composition, they speed up particularly the chain reactions that take place during the firing and at the same time, reduce the firing temperature. Thus the volume contractions resulting from the high temperature are avoided and also energy savings are achieved. For example, the amount of energy necessary to fire 12,5 kg of the wall building elements such as the standard bricks having the dimensions 24 x 29 x 24 according to the state of the art is 3750 kcal, while the amount of energy required to fire the construction elements according to the invention, with the dimensions 24 x 14.5 x 24, is 1500 kcal. In addition, the pulverized coal, shavings or styrofoam, which are the intermediate fill materials employed, have a higher mechanical strength as compared to the expanded perlite, therefore they exhibit resistance against the volumetric contractions during the firing and other mechanical constraints involved in the process, thereby contributing in a finished product obtained with desired density and dimensions. Further, since said fill materials are combustible and thus they cause the material to be fired from the interior during the firing and also lead to the formation of the gaps within the material after the firing, they are of great importance for the present production method. The expanded perlite, which is a quite lightweight material, provides the light weight for the finished product as well as exhibiting superior isolation properties in the finished product owing to its porous structure.

The construction elements present in the state of the art are not able to be produced with desired color and color shade, due to the clay material they contain reflecting the color of the added pigments in a dull manner. According to the present invention, this optional coloring process is achieved by adding the necessary pigments to the composition in the beginning of the production and the fairly low clay content aids in obtaining the material with the desired color and the color shade. The amount and the type of the pigment may be easily determined according to the colors and shades desired. Further, that the boron derivatives, which are used as the additive, are present in rather high amounts in the wastes from the boron processing facilities, means a great advantage for the production of the finished product provided by the present invention in a more economical way. Because the oxidized boron compounds rich in electron, which are available in said wastes, have properties suitable for use as the additive in the composition offered according to the present invention.

As a result, owing to the aforesaid compositions and methods provided according to the present invention, the lightweight construction elements and the lightweight construction elements with desired color are obtained, which have an extremely low weight per unit volume and heat conductivity and high strength properties, and are also quite economical. The firing temperatures for the aforesaid composition forms are in the range 800-1100°C, with the best results being obtained at a temperature of about 1000°C. The unit weight of the obtained construction element is less than 1500 kg/m^3, and the volume weight of the construction element is below 700 kg/m^3.

CLAIMS

1. A composition for the production of lightweight brick type construction elements with low density and high isolation capabilities, said composition comprising, by volume,

- 40-55% clay,
- 30-70% expanded perlite,
- 5-15% coal, shavings or styrofoam powder,
- 0,5-5% electron sourcing materials selected from tincal ($Na_2O.2B_2O_3.10H_2O$), ulexite ($NaCaB_5O_9{\cdot}8H_2O$) and albite ($NaAlSi_3O_8$).

2. A composition for production of the colored lightweight decorative construction elements with low density, high isolation capabilities and in various colors, said composition comprising, by volume,

- 4-15% clay and 35-45% quartzite,
- 50-70% expanded perlite,
- 1-10% electron sourcing materials selected from tincal ($Na_2O.2B_2O_3.10H_2O$), ulexite ($NaCaB_5O_9{\cdot}8H_2O$) and albite ($NaAlSi_3O_8$),
- dyestuff, preferably pigments, in an amount suitable for desired color.

3. A method for production of lightweight brick type construction elements with low density and high isolation capabilities, said method comprising the steps of;

a) mixing the binder agent of clay, the additive of tincal, ulexite and/or albite and the intermediate fill material of coal, shavings or styrofoam powder in a homogeneous manner,
b) wetting the expanded perlite by impregnating it with water,
c) blending said homogeneous mixture and the wetted perlite,
d) bringing the blended composition into the desired form in the shaping machine and drying the same,

e) firing the dried and shaped material to obtain the finished product.

4. A method for production of colored lightweight decorative construction elements with low density, high isolation capabilities and in various colors, said method comprising the steps of;

a) mixing a binder agent of the mixture of clay/quartz or expanded quartz, an additive of tincal, ulexite or albite and a dyestuff to provide the desired color, preferably pigments, in a homogeneous manner,

b) wetting expanded perlite by impregnating it with water,

c) blending said homogeneous mixture and the wetted perlite,

d) bringing the blended composition into the desired form in a shaping machine and drying the same,

e) firing the dried and shaped material to obtain the finished product.

5. A method for production of lightweight construction elements and colored lightweight construction elements according to Claims 3 and 4 characterized in that said firing process is performed in a temperature range of 800-1100°C.

6. A lightweight construction element or a colored lightweight construction element produced according to any one of the preceding claims.

7. A lightweight construction element or a colored lightweight construction element according to Claim 6 characterized in that the unit weight of the filled construction element is less than 1500 kg/m^3 or the volume weight of the perforated construction elements is less than 700 kg/m^3.