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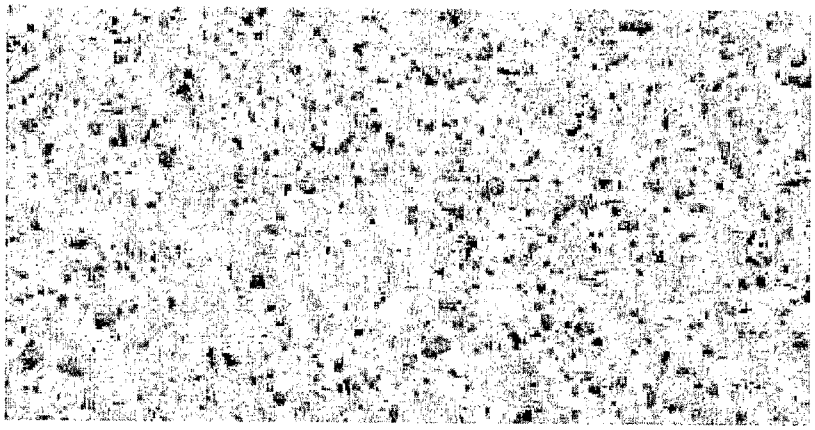
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(54) Title: INORGANIC ARTIFICIAL MARBLE AND COMPOSITION FOR INORGANIC ARTIFICIAL MARBLE

[Fig. 1]



(57) Abstract: The present invention provides an inorganic artificial marble having excellent impact strength and weather resistance. The inorganic artificial marble can be a substitute for natural stone and used as an exterior finishing material.

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Description

Title of Invention: INORGANIC ARTIFICIAL MARBLE AND COMPOSITION FOR INORGANIC ARTIFICIAL MARBLE

Technical Field

[1] The present invention relates to an inorganic artificial marble and a composition for an inorganic artificial marble.

[2]

Background Art

[3] Artificial marble used as architectural materials may be classified into two groups according to the base resin material. One group represents acrylic artificial marble, and the other group represents unsaturated polyester artificial marble. Acrylic artificial marble has found wide utilization as a material for kitchen countertops, wash basins, dressing tables, bathtubs, various table surfaces, wall materials, interior articles, and the like, because it has an excellent appearance, high-gloss texture, and good weather resistance, as compared to unsaturated polyester artificial marble. Generally, acrylic artificial marble is prepared by mixing inorganic filler and initiator and adding marble chips of various colors to provide a natural stone texture.

[4] Various patterns can be developed so that artificial marble has an appearance that is similar to natural stone. However, it can be difficult to use artificial marble as exterior finishing materials because of gloss and low weather resistance imparted thereto by the base resin, which includes an organic material. For example, conventional engineered stone has poor weather resistance because it includes an organic binder, and general cement stone may have poor chemical resistance, such as susceptibility to acidic rain, because it has a high surface pH.

[5]

Disclosure of Invention

Technical Problem

[6] The present invention provides an inorganic artificial marble which can have excellent mechanical strength and weather resistance. The present invention further provides an inorganic artificial marble which can have excellent coloring resistance and durability. The present invention further provides an inorganic artificial marble which can be environmentally friendly, can be a substitute for natural stone and can be used as an exterior finishing material.

[7] The present invention further provides a method for preparing an inorganic artificial marble which can embody a pattern resembling natural stone.

[8] The present invention further provides a composition for preparing the inorganic ar-

tificial marble.

[9]

Solution to Problem

[10] In exemplary embodiments of the present invention, the inorganic artificial marble comprises an inorganic matrix. The inorganic matrix may comprise an inorganic powder and an activator. In one embodiment of the present invention, the inorganic matrix may comprise about 5 to about 95 % by weight of the inorganic powder and about 5 to about 95 % by weight of the activator.

[11] The inorganic powder may include Al, Si, O, alkali metal and/or alkaline earth metal as an essential component, for example kaolin, brucite or a combination thereof. The inorganic powder can further comprise an alkali metal hydroxide powder, alkaline earth metal hydroxide powder, or a combination thereof. The size of the inorganic powder may be about 1 to about 100 μm.

[12] The activator may include an alkali metal silicate compound, alkaline earth metal silicate compound or a combination thereof.

[13] In another embodiment of the present invention, when the amount of inorganic material in the inorganic matrix is analyzed by IPC-OES, the inorganic material comprises about 20 to about 40 % by weight of Al and Si and about 60 to about 80 % by weight of alkali metal and/or alkaline earth metal.

[14] The inorganic matrix may further comprise an inorganic polymer such as poly(sialate), poly(sialate-siloxo), poly(sialate-disiloxo), or a combination thereof. The inorganic matrix may have an amount of about 1 to about 50 % by weight.

[15] The inorganic artificial marble may further include a chip component distributed in the inorganic matrix. The chip component may have size of about 0.5 to about 30 mm and may comprise organic chips, inorganic chips or a combination thereof. The organic chips may include unsaturated polyester chips, acrylic chips, halogenated epoxy acrylate chips, halogenated urethane acrylate chips, halogenated ethoxy acrylate di-acrylate chips or a combination thereof. The inorganic chips may include quartz, quartz-silica chips, silicate stone powder, quartz glass, synthetic quartz, silica (silicon dioxide), silica glass, mirror or a combination thereofIn exemplary embodiments of the present invention, the inorganic artificial marble may include the inorganic matrix in an amount of about 1 to about 50 % by weight and the chip component in an amount of about 50 to about 99 % by weight.

[16] The present invention further provides a composition for an inorganic artificial marble comprising about 1 to about 50 % by weight of an inorganic matrix including about 5 to about 95 % by weight of an inorganic powder (a) including about 1 to about 67.7 % by weight of Al, about 3 to about 69.7 % by weight of Si, about 20 to about

86.7 % by weight of O, and about 5 to about 95 % by weight of activator (b), and about 50 to about 90 % by weight of a chip component.

[17] The activator may comprise an alkali metal silicate compound, alkaline earth metal silicate compound, or a combination thereof. The alkali metal silicate compound, alkaline earth metal silicate compound or a combination thereof may be in the form of an aqueous solution phase having a solid content of about 1 to about 80 % by weight. The activator may include an acidic activator.

[18] The composition for an inorganic artificial marble of the present invention may be further include one or more additives such as a colorant, coupling agent, ultraviolet absorber, antistatic agent, inorganic filler and the like and combinations thereof.

[19] The composition for an inorganic artificial marble can be hardened to form the inorganic artificial marble. The inorganic artificial marble can have a pH of about 6 to about 8 measured by filtering an aqueous solution which comprises about 50 % by weight of a sanding residue powder from the artificial marble after one hour and then measuring the pH of the filtered solution.

[20] The present invention now will be described more fully hereinafter in the following detailed description of the invention.

[21]

Brief Description of Drawings

[22] FIG 1 is a picture representing a product of the inorganic artificial marble prepared according to Example 1 of the present invention.

[23] FIG 2 is a picture representing a product of the inorganic artificial marble prepared according to Example 2 of the present invention.

[24]

Best Mode for Carrying out the Invention

[25] The present invention provides an inorganic artificial marble which may have a surface pH of about 6 to about 8. The inorganic artificial marble of the invention includes an inorganic matrix, which comprises an inorganic powder and an activator. In one embodiment of the present invention, the inorganic matrix may comprise about 5 to about 95 % by weight of the inorganic powder and about 5 to about 95 % by weight of the activator.

[26] The inorganic powder may comprise one or more compounds including Al, Si, and/or O as an essential component, such as but not limited to aluminum oxide, silicon dioxide, magnesium oxide, calcium oxide, iron oxide, manganese oxide and the like and combinations thereof.

[27] In another embodiment of the present invention, the inorganic powder can include one or more kinds of oxides comprising about 1 to about 67.7 % by weight of Al,

about 3 to about 69.7 % by weight of Si, and about 20 to about 86.7 % by weight of O as an essential component. For example, the inorganic powder may comprise kaolin, brucite or a combination thereof. The inorganic powder may be prepared by baking kaolin, brucite, or a combination thereof at a temperature of at least about 300 ℃, or higher than about 350 ℃.

[28] Exemplary inorganic powders may further comprise without limitation alkali metal oxide powder, such as potassium hydroxide or sodium hydroxide, alkaline earth metal powder, and the like, and combinations thereof.

[29] The inorganic powder may have a size of about 1 to about 100 μm, for example about 5 to about 50 μm.

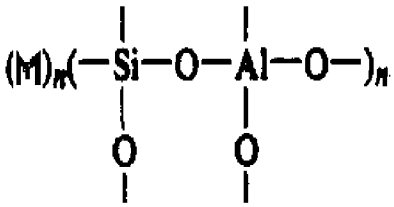
[30] Exemplary activators included in the inorganic matrix may comprise without limitation alkali metal silicate compounds, alkaline earth metal silicate compounds, and combinations thereof.

[31] In an embodiment of the present invention, when the amount of the inorganic material in the inorganic matrix is analyzed by IPC-OES, the inorganic material comprises about 20 to about 40 % by weight of Al and Si, and about 60 to about 80 % by weight of alkali metal and/or alkaline earth metal.

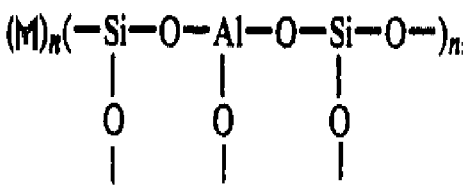
[32] The inorganic artificial marble may further comprise an inorganic polymer such as poly(sialate), poly(sialate-siloxo), poly(sialate-disiloxo), or a combination thereof. For example, the inorganic artificial marble may include an inorganic polymer having a structure represented by the following Chemical Formula 1 or Chemical Formula 2 or a combination thereof.

[33]

[34] [Chemical Formula 1]

[35] 

[36] [Chemical Formula 2]

[37] 

[38] wherein in both of Chemical Formula 1 and Chemical Formula 2, each M is independently a Group I, II or VIII element of the Periodic Table or a combination thereof, and each n represents the number of repeat units and independently can range from 1

to 100.

[39] In another embodiment of the present invention, the inorganic artificial marble includes the inorganic matrix in an amount of about 1 to about 50 % by weight and the chip component in an amount of about 50 to about 99 % by weight.

[40] The chip component may have size of about 0.5 to about 30 mm. Moreover, the chip component may have an irregular shape for embodying a natural pattern. Examples of the irregular shape may include without limitation an irregular particle shape and needle-like structure.

[41] The chip may include an inorganic chip, an organic chip or a combination thereof. The organic chip may include without limitation unsaturated polyester chip, acrylic chip, halogenated epoxy acrylate chip, halogenated urethane acrylate chip, halogenated ethoxy acrylate diacrylate chip or a combination thereof. Exemplary acrylic chips may include without limitation an acrylic artificial marble powder, an acrylic light guide plate powder and the like, and combinations thereof. In an exemplary embodiment of the present invention, the acrylic artificial marble powder may prepared by hardening about 100 parts by weight of an acrylic resin, about 100 to about 300 parts by weight of an inorganic filler, about 0.1 to about 10 parts by weight of a polymerization initiator and about 0 to about 200 parts by weight of a marble chip and pulverizing the hardened material. The chip may be transparent, semi-transparent or opaque.

[42] When the chip includes a marble chip, the chips which have a relatively small size may be prepared, thereby chip having double layer or triple layer can be formed. In another embodiment of the present invention, layers of two or more kinds of colors can be prepared.

[43] Exemplary inorganic chips may comprise without limitation broken stone chip, quartz, quartz-silica chip, silica stone powder, quartz glass, synthetic quartz, silica silicon dioxide, silica glass, mirror and the like, and combinations thereof.

[44] The present invention further provides a composition for an inorganic artificial marble comprising about 1 to about 50 % by weight of an inorganic matrix including about 5 to about 95 % by weight of an inorganic powder (a) including about 1 to about 67.7 % by weight of Al, about 3 to about 69.7 % by weight of Si, about 20 to about 86.7 % by weight of O and about 5 to about 95 % by weight of activator (b), and about 50 to about 90 % by weight of a chip component.

[45] An inorganic artificial marble can be prepared from the composition for inorganic artificial marble described above.

[46] The inorganic matrix comprising the inorganic powder (a) and the activator (b) is the same as the inorganic matrix of the inorganic artificial marble described above.

[47] Exemplary activators may comprise without limitation alkali metal silicate compounds, alkaline earth metal silicate compounds, and the like, and combinations

thereof. The alkali metal silicate compound, alkaline earth metal silicate compound or a combination thereof may be in the form of an aqueous solution phase having a solid content of about 1 to about 80 % by weight.

[48] The activator may alternatively be a colloidal solution having an alkali metal silicate and/or alkali earth metal silicate solid content of about 1 to about 80 % by weight, for example about 30 to about 70 % by weight, and as another example, about 50 to about 60 % by weight.

[49] The activator may further comprise a pH control agent. For example, the pH control agent can be an acidic pH control agent. Examples of acidic pH control agent may include without limitation sulfuric acid, nitric acid, hydrochloric acid, phosphoric acid, acetic acid, formic acid and the like, and combinations thereof. The activator which can include the acidic pH control agent may have a pH about 0.1 to about 6, for example, a pH about 1 to about 2.

[50] The composition for inorganic artificial marble may further include conventional additives such as a colorant, coupling agent, ultraviolet absorber, antistatic agent, inorganic filler and the like and combinations thereof. In an exemplary embodiment of the present invention, the colorant can be used in an amount of about 0.1 to about 5 parts by weight, for example about 0.3 to about 2 parts by weight, based on about 100 parts by weight of the composition. The inorganic filler may be used in an amount of about 0.1 about 35 parts by weight, for example about 1 to about 30 parts by weight, based on about 100 parts by weight of the composition.

[51] The inorganic artificial marble of the present invention may be prepared by hardening the composition for an inorganic artificial marble described herein and can have a surface pH of about 6 to about 8. The surface pH can be measured by filtering an aqueous solution which comprises about 50 % by weight of a sanding residue powder from the artificial marble after one hour and then measuring the pH of the filtered solution.

[52] In another exemplary embodiment of the present invention, the inorganic artificial marble may be prepared by mixing the inorganic powder and chip component (for forming a pattern) as described herein and adding a colloid solution of the acidic activator having a pH of about 0.1 to about 6 into the mixture to form a slurry. Then, the slurry can be sprayed into a molding cell, and a plate may be prepared on a flat board by vibration compression and vacuum treatment as known in the art, and cured by hardening the slurry at a temperature of about 50 to about 100 ℃ for about 0.5 to about 10 hours. The surface of resultant inorganic artificial marble may be polished to form a final product.

[53] In another exemplary embodiment of the present invention, the inorganic powder may be used in an amount of about 5 to about 85 % by weight and the colloid solution

of the acidic activator may be used in an amount of about 15 to about 95 % by weight.

[54] The artificial marble slurry may have pH of about 6 to about 8. The artificial marble slurry may be hardened at a temperature of about 20 to about 100 ℃, for example about 60 to about 90 ℃.

[55] The surface pH of the inorganic artificial marble can be measured by filtering an aqueous solution which comprises about 50 % by weight of a sanding residue powder of the artificial marble after one hour and then measuring the pH of the filtered solution. For example, the surface pH may be about 6.5 to about 7.5. Accordingly, the prepared inorganic artificial marble may not suffer surface corrosion after being exposed to acid rain and can have excellent durability without deterioration.

[56] As discussed herein, the inorganic artificial marble can have a pH of about 6 to about 8 because it includes an inorganic mixture, and not a resin or general cement material. Accordingly, the prepared inorganic artificial marble can replace natural stone and be used as an exterior finishing material due to its excellent impact strength, coloring resistance, weather resistance and durability.

[57] The invention may be better understood by reference to the following examples which are intended for the purpose of illustration and are not to be construed as in any way limiting the scope of the present invention, which is defined in the claims appended hereto.

[58]

Mode for the Invention

[59] **Example 1**

[60] An inorganic powder is prepared by baking kaolin and brucite at 350 ℃ and thereafter pulverizing the baked kaolin and brucite. An inorganic artificial marble slurry is prepared by mixing 90 parts by weight of quartz-silica chip and 10 parts by weight of the inorganic powder and 30 parts by weight of an acidic activator with a pH of 1 is added to the mixture. The acidic activator is prepared by adding hydrochloric acid to an aqueous solution including a solid content of 55 % by weight of sodium silicate and potassium silicate to adjust the pH of the aqueous solution to 1.

[61] The artificial marble slurry is sprayed into a molding cell, and a plate is prepared on a flat board by vibration compression and vacuum treatment, and cured by hardening at 70 ℃ for 3 hours. Then, the final inorganic artificial marble product is prepared by polishing the surface. The surface is represented by Fig 1.

[62] The surface pH is measured by filtering an aqueous solution which comprises 50 % by weight of a sanding residue powder of the artificial marble after one hour, and the surface pH is 7. 3 g of hydrochloric acid is dropped onto the surface of the prepared artificial marble, the surface is wiped, and surface corrosion does not appear.

[63] To test weather resistance, a Q-UV test is conducted and the value of △E is measured using a colorimeter (Minolta Co., Ltd., CM-370) after irradiating the sample with ultraviolet rays for 24 hours using a uvcon device (Atlas Electrical Devices Co.). The value of △E is 0.42, and the coloring resistance and weather resistance are excellent.

[64]

[65] **Example 2**

[66] Example 2 is prepared in the same manner as Example 1 except that quartz-silica chip is replaced with broken stone chip. The surface pH is 7. A picture of the surface of the prepared artificial marble is represented by Fig 2. 3 g of hydrochloric acid is dropped onto the surface of the prepared artificial marble, the surface is wiped, and surface corrosion does not appear. The value of △E is 0.41, and the coloring resistance and weather resistance are excellent as in Example 1.

[67]

[68] **Comparative Example 1**

[69] Comparative Example 1 is prepared in the same manner as Example 1 except that an activator which does not include hydrochloric acid is used after the aqueous solution which comprises a sodium silicate and potassium silicate solid content of 55 % by weight is prepared. The surface pH is 13. 3 g of hydrochloric acid is dropped onto the surface of the prepared artificial marble, the surface is wiped, and surface corrosion appears.

[70]

[71] **Comparative Example 2**

[72] Organic engineered stone (E-stone) (Hanwha L&C Corporation, Khanstone) is prepared by using 10 % by weight of silica chip and 90 % by weight of unsaturated polyester organic binder. The value of △E of the organic engineered stone is 3.0, and the coloring resistance and weather resistance are relatively poor.

[73] Many modifications and other embodiments of the invention will come to mind to one skilled in the art to which this invention pertains having the benefit of the teachings presented in the foregoing descriptions. Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

Claims

[Claim 1] An inorganic artificial marble comprising an inorganic matrix.

[Claim 2] The inorganic artificial marble of Clam 1, wherein said inorganic artificial marble has a surface pH of about 6 to about 8.

[Claim 3] The inorganic artificial marble of Clam 1, wherein said inorganic matrix comprises an inorganic powder and an activator.

[Claim 4] The inorganic artificial marble of Clam 2, wherein said activator comprises an alkali metal silicate, an alkaline earth metal silicate or a combination thereof.

[Claim 5] The inorganic artificial marble of Clam 3, wherein said inorganic powder comprises Al, Si and O.

[Claim 6] The inorganic artificial marble of Clam 3, wherein said inorganic powder comprises kaolin, brucite or a combination thereof.

[Claim 7] The inorganic artificial marble of Clam 6, wherein said inorganic powder comprises alkali metal oxide powder, alkaline earth metal powder or a combination thereof.

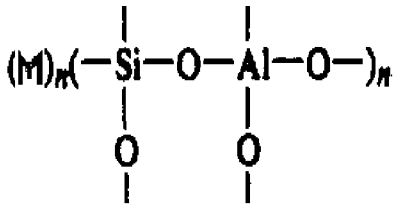
[Claim 8] The inorganic artificial marble of Clam 3, wherein said inorganic powder has a size of about 1 to about 100 μm.

[Claim 9] The inorganic artificial marble of Clam 1, wherein an inorganic material in the inorganic matrix comprises about 20 to about 40 % by weight of Al and Si and about 60 to about 80 % by weight of an alkali metal, alkaline earth metal, or a combination thereof when the inorganic material is analyzed by IPC-OES.

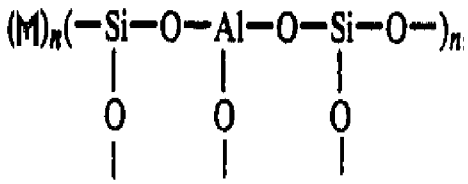
[Claim 10] The inorganic artificial marble of Clam 1, further comprising an inorganic polymer comprising poly(sialate), poly(sialate-siloxo), poly(sialate-disiloxo), or a combination thereof.

[Claim 11] The inorganic artificial marble of Clam 1, wherein said inorganic polymer comprises a structure represented by the following Chemical Formula 1 or Chemical Formula 2 or a combination thereof:

[Chemical Formula 1]



[Chemical Formula 2]



wherein in both of Chemical Formula 1 and Chemical Formula 2, each M comprises a Group I, II, or VII element of the Periodic Table, or a combination thereof and each n represents the number of repeat units.

[Claim 12] The inorganic artificial marble of Clam 1, further comprising a chip component.

[Claim 13] The inorganic artificial marble of Clam 12, wherein said chip component has size of about 0.5 to about 30 mm.

[Claim 14] The inorganic artificial marble of Clam 12, wherein said chip component comprises organic chips, inorganic chips or a combination thereof.

[Claim 15] The inorganic artificial marble of Clam 14, wherein said organic chip comprises unsaturated polyester chip, acrylic chip, halogenated epoxy acrylate chip, halogenated urethane acrylate chip, halogenated ethoxy acrylate diacrylate chip or a combination thereof.

[Claim 16] The inorganic artificial marble of Clam 14, wherein said inorganic chip comprises broken stone chip, quartz, quartz-silica chip, silica stone powder, quartz glass, synthetic quartz, silica silicon dioxide, silica glass, mirror or a combination thereof.

[Claim 17] The inorganic artificial marble of Clam 12, comprising the inorganic matrix in an amount of about 1 to about 50 % by weight and the chip component in an amount of about 50 to about 99 % by weight.

[Claim 18] An inorganic matrix comprising:
(a) about 5 to about 95 % by weight of an inorganic powder including about 1 to about 67.7 % by weight of Al, about 3 to about 69.7 % by weight of Si and about 20 to about 86.7 % by weight of O; and
(b) about 5 to about 95 % by weight of an activator.

[Claim 19] A composition for an inorganic artificial marble comprising:
about 1 to about 50 % by weight of an inorganic matrix, the inorganic matrix comprising (a) about 5 to about 95 % by weight of an inorganic powder including about 1 to about 67.7 % by weight of Al, about 3 to about 69.7 % by weight of Si and about 20 to about 86.7 % by weight of O, and (b) about 5 to about 95 % by weight of activator, and
about 50 to about 90 % by weight of a chip component.

[Claim 20] The composition of Claim 19, wherein said activator comprises an alkali metal silicate compound, an alkaline earth metal silicate compound or a combination thereof.

[Claim 21] The composition of Claim 20, wherein said alkali metal silicate compound, alkaline earth metal silicate compound or a combination thereof is in the form of an aqueous solution phase having a solids content of about 1 to about 80 % by weight.

[Claim 22] The composition of Claim 19, wherein said activator comprises an acidic activator.

[Claim 23] The composition of Claim 22, wherein said activator further comprises a pH control agent.

[Claim 24] The composition of Claim 22, wherein the pH of the activator is about 0.1 to about 6.

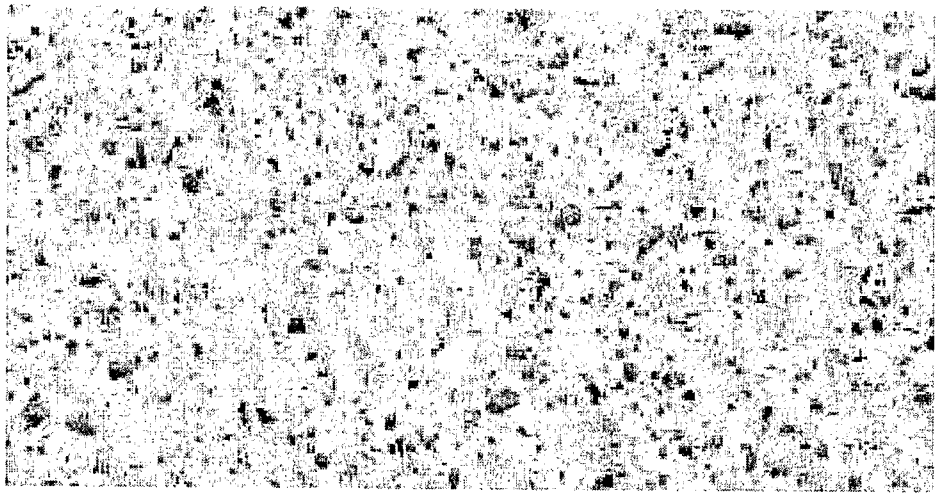
[Claim 25] The composition of Claim 22, wherein the pH of the activator is about 1 to about 2.

[Claim 26] The composition of Claim 19, wherein said composition for inorganic artificial marble of the present invention further comprise an additive comprising a colorant, coupling agent, ultraviolet absorber, antistatic agent, inorganic filler or a combination thereof.

[Claim 27] An inorganic artificial marble prepared by hardening the composition for inorganic artificial marble of Claim 19, and having a surface pH of about 6 to about 8 measured by filtering an aqueous solution comprising about 50 % by weight of a sanding residue powder of the artificial marble after one hour.

[Claim 28] The inorganic artificial marble of Claim 27, wherein said inorganic artificial marble comprises an inorganic matrix comprising an inorganic material comprising about 20 to about 40 % by weight of Al and Si and about 60 to about 80 % by weight of alkali metal, alkaline earth metal, or a combination thereof when the inorganic material is analyzed by IPC-OES.

[Fig. 1]



[Fig. 2]

