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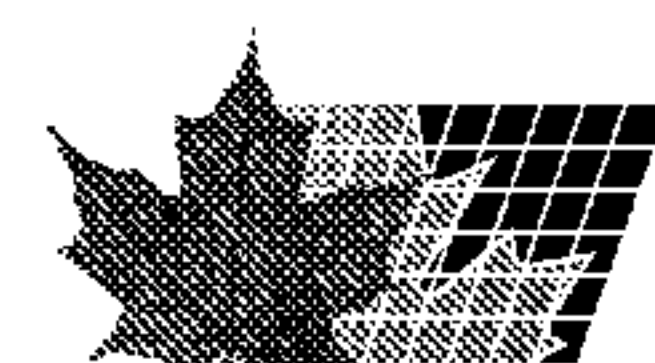
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(54) Title: THE MANUFACTURING METHOD OF CONSTRUCTION MATERIALS USING WATERWORKS SLUDGE

(57) **Abrégé/Abstract:**

Disclosed are a soundproof construction composition using waterworks sludge and a method for preparing the same. The soundproof construction composition using waterworks sludge manufactured by mixing 22% by weight of a first processed clean water sludge made by firing waterworks sludge for 3-5 hours at 800°C-850°C, with 18% by weight of clay, 36% by weight of terra alba, 14% by weight of agalmatolite, and 10% by weight of dolomite to obtain a body; mixing 31.5% by weight of the body with 2.3% by weight of calcined gypsum, 11.3% by weight of cement, 0.05% by weight of aluminum powder, 0.5% by weight of starch, 0.5% by weight of titanium dioxide to prepare a powdery mixture; and mixing the powdery mixture with 10.8% by weight of phosphoric acid and 43.05% by weight of water.



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THE MANUFACTURING METHOD OF CONSTRUCTION MATERIALS USING WATERWORKS SLUDGE

Technical Field

[1] The present invention relates to a soundproof construction composition using waterworks sludge and a method for preparing the same. More specifically, the invention relates to a soundproof construction composition using waterworks sludge, which is prepared by first firing waterworks sludge at 8000C to obtain a first processed material, and forming many pores within a body prepared by using the first processed material, through a chemical foaming method in which hydrogen gas is generated by reaction of aluminum powder with an acid or an alkali, and a method for preparing the same.

Background Art

[2] Products in which many pores are formed naturally or artificially in ceramic materials have been long progressed for adiabatic, lightweight, soundproof, heat insulation, filtration purposes.

[3] Their representative examples include an adiabatic brick, a lightweight concrete product, a porous glass, and a porous carbon material, etc. Pyrogenic sites of a spacecraft, which can be called an advanced high-technology, are attached with porous silica tiles.

[4] A porous inorganic product can be considered to be an interesting field in terms of the manufacture of a soundproof product in that the expression of the feel of surfaces can be extended due to various pores scatteringly formed on the surface, resistance against injury due to quick drying, quick heating or quick cooling during drying or firing process of a product can be increased, the shape of the fired product can be changed like cutting fire-resistant adiabatic brick with a saw and processing it, and the form of the product can be widely pursued, particularly the weight of the product can be decreased in large soundproof product since the body is in a slip state and the range of selecting the material of a pouring mold is wide like wood, vinyl, Styrofoam, etc.

[5] Such a porous inorganic material is mostly manufactured artificially, for example, a chemical foaming method using aluminum powder as a foaming agent is widely used.

[6] There are fine particulates in waterworks water, and accordingly much finer particulate material than artificially formed particulate can be obtained therefrom.

[7] Since particles in water are very fine, it is easy to render a product lightweight and to occur reaction therewith.

[8] Korean Patent No. 10-0327944 discloses a manufacturing method of an artificial culture soil and artificial culture soil fertilizer using water sludge.

[9] Korean Patent No. 10-0625172 discloses a manufacturing method of soil concrete and soil concrete block using expansive agent or hydro-depository agent wherein clay including loess, sandy soil including polishing sand, paper sludge, water sludge, stone dust, expansive cement, sodium alginate, aggregate, cement, and at least one resin selected from the group consisting of polyethylene resin, polystyrene resin, polypropylene resin, melamine resin and fluorine resin are applied on the soil concrete.

[10] Korean Patent Laid-Open Publication No. 10-1999-0007639 discloses a ceramic composition comprising 75 parts by weight of solid waste, 15 to 45 parts by weight of fly ash and 5 to 55 parts by weight of clay, and a method of manufacturing the same.

[11] Korean Patent Laid-Open Publication No. 10-2001-0008071 discloses clay brick, clay block for footpath-roadway manufactured by adding kaolin and clay to water sludge and stirring them, then pressing them with high pressure press and drying them, and then heating them, and a method of manufacturing the same.

[12] Korean Patent Laid-Open Publication Nos. 10-1992-0000655 and 10-1997-0005872 disclose ondol magnetic composition consisting of elvan and mica and possessing magnetic force, and a method of manufacturing construction material.

[13] Korean Patent Laid-Open Publication No. 10-1997-0001067 discloses a glaze composition for treating a ceramic vessel to treat surfaces of ceramic material such as chinaware.

[14] Korean Patent Laid-Open Publication No. 10-1997-0010301 discloses a process for manufacturing far- infrared radiating ceramic essentially consisting of elvan and having strong radiating characteristic generating far-infrared ray.

[15] Korean Patent Laid-Open Publication No. 10-1995-0023626 discloses a mortar composition comprising elvan and cement in the ratio of 3.2: 1.

[16] Korean Patent Laid-Open Publication No. 10-1993-0019580 discloses a knockdown warming ondol panel manufactured by combining natural inorganic mineral sericite ore in which germanium mineral is contained and elvan mineral with cement and refining them.

[17] The above prior arts have problems that contraction occurs during firing or cooling in process for manufacturing construction material, and raw material costs high and accordingly they could not be practically used, particularly in soundproofing field.

Disclosure of Invention

Technical Problem

[18] Accordingly, the present invention has been made in an effort to solve the problems occurring in the prior art. It is an object of the invention to provide a soundproof construction composition using waterworks sludge that increases beneficial effects such as soundproof, moistureproof, heat protection and no environmental pollution by solving the problems of a soundproofing material for a polymer completely, and a method for preparing the same, as an improvement of Korean Patent No. 10-622394 (Application No. 10-2004-56950) and Korean Patent No. 10-663235 (Application No. 10-2004-56949) entitled "A method of preparing a construction material using waterworks sludge" and "A composition of construction material using waterworks sludge and a method of preparing the same," respectively.

Technical Solution

[19] If waterworks sludge is first fired at 800⁰C, organic material of the sludge is burnt, and then the contraction of the sludge is completed to obtain a first processed material. Then a chinaware body fired at 1100⁰C is manufactured by employing the processed sludge, and clay, dolomite,

terra alba and pottery stone, and then pores are formed thereon by carrying out acid and alkali reaction employing aluminum powder as a foaming agent. The product manufactured like this has characteristics that it is easy to dry it, its resistance against quick heating or cooling is strong, it is lightweight and its soundproof effect is superior, and it causes no environmental pollution and its adiabatic effect is increased due to its high heat resistance compared to prior art soundproofing material having low adiabatic property and environmental pollution problem.

Advantageous Effects

[20] As described above, the product according to the present invention can increase beneficial effects such as soundproof, moistureproof, heat protection, no environmental pollution by solving the problems of the prior art soundproof material completely by:

[21] first firing waterworks sludge at 8000C, thereby burning organic material of the sludge to obtain a first processed material in which the contraction of the sludge is completed,

[22] manufacturing chinaware body fired at 11000C by employing the processed sludge, and clay, dolomite, terra alba and pottery stone,

[23] forming innumerable pores on the chinaware body in which the processed sludge is contained, thereby obtaining a product according to the present invention having advantages that its resistance against quick heating or cooling is strong, it is lightweight and its soundproof effect is superior, and thus it causes no environmental pollution and its adiabatic effect is increased due to its high heat resistance compared to prior art soundproofing material having low adiabatic property and environmental pollution problem.

[24] Further, a porous body is chemically foamed by generating hydrogen gas through reaction of aluminum powder with an acid or an alkali after slipping the body. The porous body can express the feel of surface naturally by pores contained in everywhere of the surface, the material of a pouring mold can be employed in organic material such as vinyl, and the porous body is effective in manufacturing large soundproof product since it is dried easily, has strong resistance against quick heating or cooling, and the weight of a product made therefrom is lightweight.

Mode for the Invention

[25] In order to accomplish the above object, according to one aspect of the present invention, there are provided a soundproof construction composition using waterworks sludge, having a total contraction rate of 8-10% and an apparent porosity of 50-52%, which is manufactured by mixing 22% by weight of a first processed clean water sludge made by firing waterworks sludge for 3-5 hours at 800°C-850°C, with 18% by weight of clay, 36% by weight of terra alba, 14% by weight of agalmatolite, and 10% by weight of dolomite to obtain a body, mixing 31.5% by weight of the body with 2.3% by weight of calcined gypsum, 11.3% by weight of cement, 0.05% by weight of aluminum powder, 0.5% by weight of starch, 0.5% by weight of titanium dioxide to prepare a powdery mixture, and mixing the powdery mixture with 10.8% by weight of phosphoric acid and 43.05% by weight of water, stirring the resultant mixture, and firing it at 1100°C in heating furnace, and a method for preparing the same.

[26] The body according to the present invention was chinaware body fired at 1100°C, phosphoric acid fluid was used in acid reaction foaming and sodium hydroxide was used in alkali reaction foaming as a foaming promoter. Further, a dispersant and a foam stabilizer were used as other aids.

[27] In the present invention, the concentration of the body slip suitable for foaming is decided, the effect of the calcined gypsum and cement on setting-hardening reaction of the slip and the combination rate are elicited, and its handling strength and firing property were examined.

[28] In the acid reaction foaming, foaming phenomenon depending on the combined amount of phosphoric acid, the effect of titanium dioxide as a foaming promoter, the effect of the calcined gypsum and cement and their proper amounts, drying and firing property were examined.

[29] In the alkali reaction foaming, the proper amounts of sodium hydroxide as a foaming promoter, the setting-hardening state of the calcined gypsum and cement, drying and firing property, and the added amounts of silver white for providing firing strength were experimented and observed.

[30] Further, the present inventors observed forming possibility and drying and firing state, and investigated the compatibility with glaze when using rag or Styrofoam rather than gypsum as a mold in setting-hardening reaction of porous body with manufacturing a trial product.

[31] If aluminum powder reacts with an acid or an alkali, hydrogen gas is generated, thereby forming foam and forming many pores within the body. Therefore, three points of component, fineness and particle type are uniform, non-oxidized state is important, and large specific surface area is preferable, i.e., the fineness is less than 50 micros.

[32] It is known that a foam promoter such as sodium hydroxide, a surfactant and a foam stabilizer are preferably used in combination with aluminum powder.

[33] Such other aids are described below.

[34] Aluminum was used as a foaming agent, and in slip using aluminum, sodium hydroxide is mainly used and potassium hydroxide is sometimes used as a foaming promoter in order to supplement the lack of alkali and promote to foam.

[35] A dispersant disperses each component in the slip. A surfactant such as an organic acid, e.g., lignin-sulfonate, and a polymer counteragent is used, but the dispersant may not be used in the present invention.

[36] A foam stabilizer stabilizes foam within slip, prevents foam from aggregating and distributes uniformly. Saponin, protective colloid or starch, etc. were used as such a foam stabilizer.

[37] Further, a hardening accelerator is a dilute slip containing much water in body raw material, and thus has strength through setting-hardening reaction of cement rather than drying. At this time, calcium oxide, its salt and water glass, etc. were used for shortening the setting time.

[38] Hereinafter, the present invention will be explained in details with reference to Examples.

[39] *Example*

[40] A first process (processing of a first processed clean water sludge)

[41] 1 ton of sludge generated in waterworks purification plant was put in a rotary kiln, and fired for 3-5 hours at 800°C-850°C to completely remove water and organic material from the sludge to thereby produce 80-500kg of a first processed clean water sludge.

[42] The second process (preparation of a body)

[43] 22kg of the first processed clean water sludge, 18kg of clay, 36kg of terra alba, 14kg of agalmatolite, and 10kg of dolomite were mixed, and then pulverized with a ball mill and passed through a 200-mesh sieve to manufacture a body of which residual amount is less than 1%.

[44] The third process (manufacturing of construction material)

[45] 31.5kg of the body prepared in the above second process, 2.3kg of calcined gypsum passed through a 20-mesh sieve, 11.3kg of cement passed through the 20-mesh sieve, 0.05kg of aluminum powder, 0.5kg of starch and 0.5kg of titanium dioxide were mixed to prepare a powdery mixture,

[46] 10.8kg of phosphoric acid and 43.05kg of water were mixed, and then the mixture was mixed with the powdery mixture, the resultant mixture was stirred, and fired at 11000C in heating furnace to prepare the soundproof construction material using waterworks sludge, having a total contraction rate of 8-10% and an apparent porosity of 50-52%.

[47] *Experimental example*

[48] Raw material

[49] The basic body used in this experiment was a chinaware body fired at 11000C using the first processed waterworks sludge, and its combination rate was as follows.

[50] 18% by weight of clay, 36% by weight of terra alba, 22% by weight of the first processed clean water sludge, 14% by weight of agalmatolite, and 10% by weight of dolomite. The particle

size of the body was such that residual amount is less than 1% when the body was passed through a 200-mesh sieve.

[51] Aluminum powder used as a foaming agent is a product available at H-non-iron powder company and is employed in paints, etc. Dish cleaner which is a surfactant was used as a dispersant, starch was used as a foam stabilizer, calcined gypsum was the second grade product of M-chemistry, general Portland cement was used as a cement, and sodium hydroxide and phosphoric acid aqueous solution were commercially available industrial products.

[52] Manufacturing of a test piece

[53] A body was dried and pulverized, and then passed through a 20-mesh sieve. The resultant body in powdery state was used. Calcined gypsum and cement were also sieved through 20-mesh sieve, and ultimately their powder in no mass state was used.

[54] The raw material used in the experiment is categorized into solid in powder state and liquid such as water or phosphoric acid. Combining the raw material was performed in principle by first mixing solid with solid and mixing liquid with liquid, and then putting solid sample in liquid sample. The soluble material such as sodium hydroxide was first dissolved in water.

[55] Aluminum powder, which is a foaming agent, was dispersed in water in a state well mixed with a surfactant.

[56] The weight of the test piece was such that the total amounts of the three raw materials, i.e., a body, calcined gypsum and cement are 50g. Other aids such as a foaming promoter were additives.

[57] Combined solid sample was well mixed and put in liquid sample, and thus the solid sample absorbs water completely. Then the mixture was stirred to prepare slip, and then the slip was put in 100cc beaker. Then the foaming reaction was observed while a mold releasing agent was applied with a brush so that the test piece can be easily separated after the sample was dried within the beaker.

[58] Foaming temperature and drying

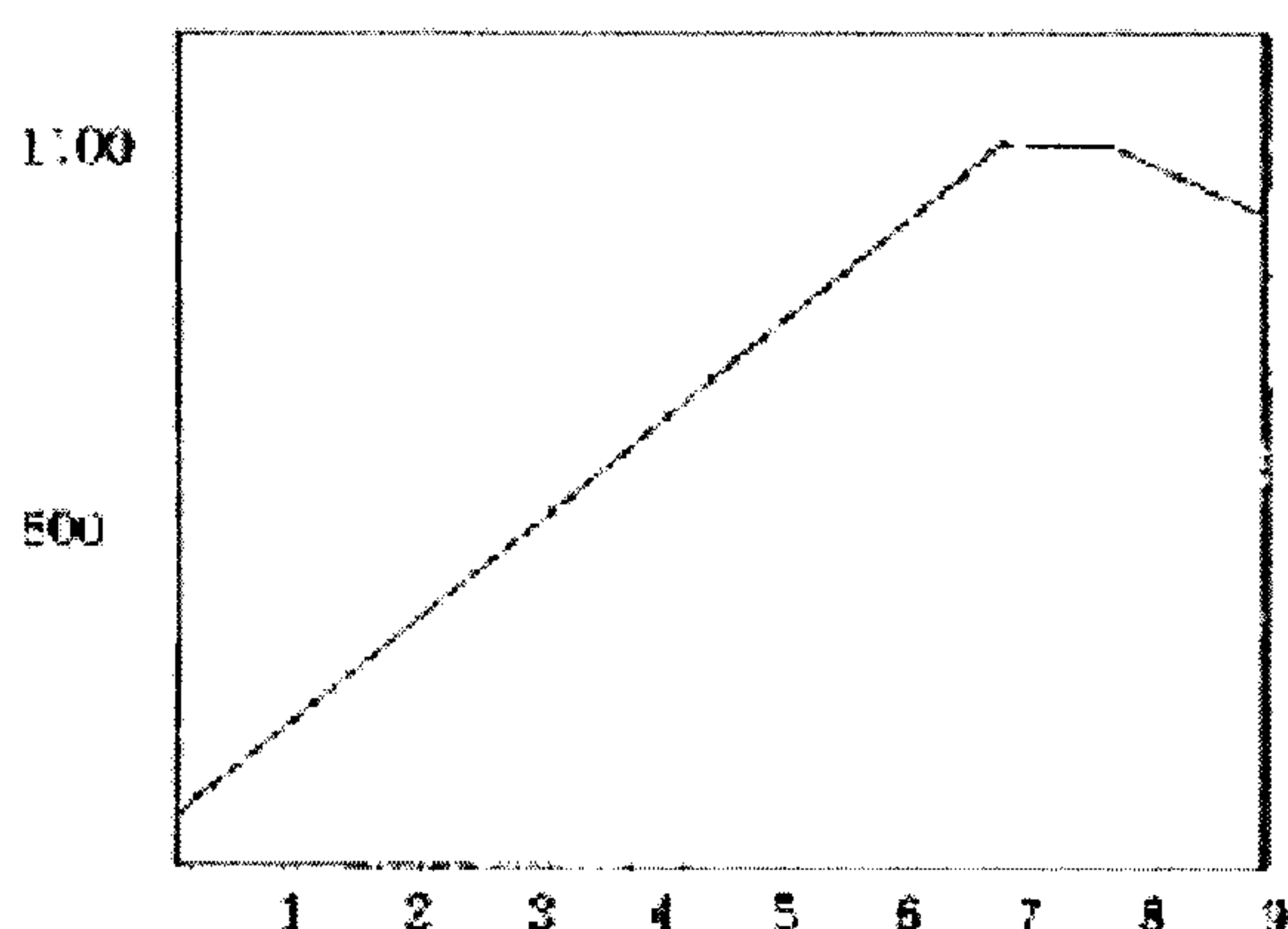
[59] The foaming reaction of the sample was well performed at ambient temperature in acid foaming, and at 60-80°C for promoting foaming in alkali foaming. The apparatus at this time was constant temperature dryer.

[60] The test pieces were taken out and naturally dried when some were dried with setting-hardening in a state being separable from a container such as a beaker.

[61] Firing

[62] An electric furnace using a kanthal wire as a pyrogen was used in firing the test pieces, and the rising temperature curve is as follows.

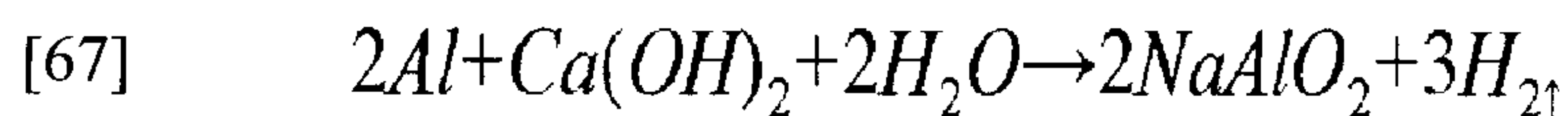
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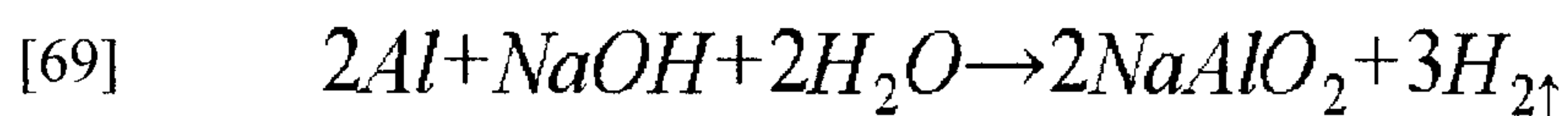
[64] If lime or Portland cement is applied to soil in order to setting-hardening soil, it reacts with clay mineral having reactivity. The action at this time can be setting- hardening phenomenon of cement.

[65] If water is added to cement, and then they were kneaded, hydration reaction occurs, and thus slip mixture is set to solid as time goes by, and the slip mixture undergoes the step of being capable of barely maintaining form, thereby having mechanical strength gradually.

[66] The advantages of this product are that it is lightweight, has high sound-absorbing property and adiabatic property, it is easy to process, and has high heat resistance. Aluminum powder is employed as a foaming agent of this product, and its reaction is as follows.



[68] Sodium hydroxide is used in order to supplement the lack of alkali and promote to foam, and its reaction at this time is as follows.



[70] A porous body is chemically foamed by generating hydrogen gas through reaction of aluminum powder with an acid or an alkali after slipping the body. The porous body can express the feel of surface naturally by pores contained in everywhere of the surface, the material of a pouring mold can be employed in organic material such as vinyl, and the porous body is effective in manufacturing large soundproof product since it is dried easily, has strong resistance against quick heating or cooling, and the weight of a product made therefrom is lightweight.

[71] Accordingly, this experiment forms many pores on the body by acid reaction and alkali reaction. As a result, in manufacturing a product, the range of selecting the pouring mold is widen, the foaming reaction is well achieved at ambient temperature, and the acid reaction foaming is good so that the feel of surface may be natural since pores having various sizes are contained in everywhere of the surface, wherein the combining rate by weight is as follows:

[72] 31.5% by weight of the body, 2.3% by weight of calcined gypsum, 11.3% by weight of cement, 10.8% by weight of phosphoric acid, 43.05% by weight of water, 0.05% by weight of aluminum powder, 0.5% by weight of starch and 0.5% by weight of titanium dioxide.

[73] The result of the experiment:

[74] 1) handling strength easy to work can be obtained by combining less than 30% of calcined gypsum and cement in a body, then foaming, and setting-hardening since the slip of the body suitable for foaming has dilute concentration requiring much water compared to the body.

[75] 2) the effects that foaming is active, the strength after firing is increased, and color becomes white as phosphoric acid (85% solution) increases in acid reaction foaming were obtained. The combining ratio of phosphoric acid suitable for firing at 1100⁰C is proper within 10% of the slip weight.

[76] 3) if titanium dioxide is added within 1% in the acid reaction foaming experiment, the foaming reaction is greatly promoted and varying sizes of pores can be obtained.

[77] 4) sodium hydroxide promoted foaming reaction in the alkali reaction foaming, and its amount was about 0.5% of the slip weight. If reaction temperature is maintained at 60-80°C rather than ambient temperature, foaming is easily achieved.

[78] 5) since the firing strength is very weak in firing at 1100°C with alkali reaction foaming material, the drawback can be complemented by adding silver white as strength reinforcing material.

[79] 6) the fired porous soundproof material has about 8-10% of total contraction rate and about an apparent porosity of 50-52%.

[80] 7) a mold having desired shape can be manufactured, forming is possible in the mold, the product is lightweight, and a product having natural pores formed on its surface can be manufactured.

Industrial Applicability

[81] As described above, a soundproof construction composition using waterworks sludge according to the present invention increases beneficial effects such as soundproof, moistureproof, heat protection and no environmental pollution. A porous body according to the present invention is chemically foamed by generating hydrogen gas through reaction of aluminum powder with an acid or an alkali after slipping the body. The porous body can express the feel of surface naturally by pores contained in everywhere of the surface, the material of a pouring mold can be employed in organic material such as vinyl, and the porous body is effective in manufacturing large soundproof product since it is dried easily, has strong resistance against quick heating or cooling, and the weight of a product made therefrom is lightweight.

Claims:

[1] A construction composition using sludge generated in a waterworks purification plant having a total contraction rate of 8-10% and an apparent porosity of 50-52%, prepared by:

mixing 22% by weight of a first processed sludge made by firing sludge generated in a waterworks purification plant for 3-5 hours at 800°C-850°C, with 18% by weight of clay, 36% by weight of terra alba, 14% by weight of pottery stone, and 10% by weight of dolomite to obtain a first powder mixture,

mixing 31.5% by weight of the first powder with 2.3% by weight of calcined gypsum, 11.3% by weight of cement, 0.05% by weight of aluminum powder, 0.5% by weight of starch, 0.5% by weight of titanium dioxide to obtain a second powder mixture, and,

mixing the second powder mixture with 10.8% by weight of phosphoric acid and 43.05% by weight of water and firing the resultant mixture in a heating furnace.

[2] A method of preparing a construction composition using sludge generated in a waterworks purification plant, having a total contraction rate of 8-10% and an apparent porosity of 50-52% comprising:

a first step of putting 1 tonne of sludge generated in the waterworks purification plant in a rotary kiln, and firing it for 3-5 hours at 800°C-850°C to completely remove water and organic material from the sludge to thereby produce 80-500kg of a first processed sludge;

a second step of mixing 22% by weight of the first processed sludge, 18% by weight of clay, 36% by weight of terra alba, 14% by weight of pottery stone, and 10% by weight of dolomite, and then pulverizing with a ball mill passing it through a 200-mesh sieve to obtain a first powder mixture having residue content of less than 1%; and,

a third step of mixing 31.5% by weight of the first powder mixture prepared in said second step, 2.3% by weight of calcined gypsum passed through a 20-mesh sieve, 11.3% by weight of cement passed through the 20-mesh sieve, 0.05% by weight of aluminum powder, 0.5% by weight of starch and 0.5% by weight of titanium dioxide to prepare a second powder mixture, and adding to the second powder mixture 10.8% by weight of phosphoric acid and 43.05% by weight of water, and then stirring and firing the resulting mixture at 1100°C in a heating furnace.