(54) Title: EPOXY RESIN MORTAR COMPOSITION AND A METHOD OF COATING THE SAME ON CONCRETE SURFACE

(57) Abstract: This invention relates to an epoxy resin mortar composition and a method of coating the same on concrete surface. More particularly, this invention relates to an epoxy resin mortar composition which is used as a material for the purpose of reinforcing surface and improving external feature in finishing up the concrete surface wherein the epoxy basal resin is converted to have a low-viscous immobiity to give dimorphism.
EPOXY RESIN MORTAR COMPOSITION AND A METHOD OF COATING THE SAME ON CONCRETE SURFACE

TECHNICAL FIELD OF THE INVENTION

[0001] This invention relates to an epoxy resin mortar composition and a method of coating the same on concrete surface. More particularly, this invention relates to an epoxy resin mortar composition which is used as a material for the purpose of reinforcing surface and improving external feature in finishing up the concrete surface wherein the epoxy basal resin is converted to have a low-viscous immobility to give dimorphism. When thus prepared immobile resin composition is mixed with natural-, artificial-, colored silica sand or an inorganic compound and used to perform a mortar construction on floor, wall, slope and curved concrete surfaces, it enables to fill in the internal voids thus allowing full freedom in plastering process while maintaining its original shape. Further, when paving and press plastering are performed simultaneously on the concrete surface by using a machine it can form a standardized mortar surface thereby greatly improving physical properties and workability.

BACKGROUND OF THE INVENTION

[0002] Generally, chemical resin has been widely used as a material for reinforcing and improving external structure in finishing up concrete floor surface, in particular, an epoxy resin due to its excellent physical properties.

[0003] Of the methods for conducting floor surface construction such as coating, lining, resin mortar, etc., resin mortar method has been most widely applied due to its superior physical properties resulting in semi-permanent structural product. However, there are some drawbacks in resin mortar method such as insufficient adhesiveness with concrete floor surface, a complicated construction procedure, an unsophisticated finished state.
[0004] To remedy the unsophisticated finished state in the finishing process the inventors of the present invention had attempted to apply an epoxy resin mortar composition disclosed in Korean Patent No. 0145117. However, this method has been considered rather inefficient due to its rather complicated construction procedure and thus other methods to improve the drawbacks are being tested.

[0005] The typical process of epoxy resin mortar construction method comprises: 1) shot blasting of concrete floor (base), 2) primer coating, 3) scrapping, 4) paving, 5) press-forming plaster, 6) reinforced coating, 7) top coating, and 8) finish coating.

[0006] The process of thiso-type coating construction method by the present inventors comprises: 1) shot blasting of concrete floor (base), 2) primer coating, 3) scrapping, 4) paving of mortar, 5) press-forming plaster, 6) reinforced coating, 7) thiso-type coating, and 8) top coating & finish coating. This method provides an improved sophisticatedness and workability, however, there still remains room for improvements such as reduction in construction period and procedural steps.

[0007] As stated, the epoxy resin mortar surface construction method has been widely used worldwide. However, this method is very similar to the conventional ones and thus there is a need for the development of a procedure which is more competitive in terms of quality, constructional workability, and cost.

[0008] Generally, in the construction method using epoxy resin, resin with an intermediate level of viscosity is mixed with artificial silica sand or colored silica sand and then spread over the concrete floor surface to have the thickness of about 3 to about 5 mm followed by press-forming plastering using a finisher. The resins used in the above method have good flowability with an intermediate level of viscosity to be well mixed with silica sand and also provide easier press-forming plastering. However, it has drawbacks that plastering and maintaining a shape of mortar layer are possible only when a predetermined small amount of resin is used.
with reference to the amount of silica sand. That is, from the point of functional efficiency, it is required to have cohesiveness due to high viscosity or to maintain high viscosity state to inhibit flowability considering physical properties. However, unflowable resin is impregnated in large amount in an inorganic material other than silica sand, it is difficult to obtain a desirable plastering or a finalized product thereof due to its tackiness and opaqueness. Therefore, the conventional methods were not able to reduce procedural steps or provide sophisticated surface.

[0009] In conventional methods using epoxy resin mortar, about 10 to about 12 parts by weight of resin is mixed with 100 parts by weight of silica sand to form a mortar layer, and its construction is limited on the floor surface. If the resin content is higher than the above content it is impossible to perform construction due to its tackiness and also cannot form a desirable surface shape because the resin is directed to a side with lower height.

[0010] The mortar surface formed by using a mixture of the above resin and silica sand according to the above mixed ratio can have voids after curing and thus it is necessary to fill in the voids using a mixture, where about 15 to about 20 parts by weight of resin is mixed with about 100 part by weight of silica sand, by penetrating it through the surface. Then, after curing is completed, a mixture having about 3 parts by weight of resin per about 100 parts by weight of silica sand is used for top coating and finishing coating to finally obtain a desired surface. In general, surface completed as a result of complicated constructional procedure is provided with a relatively high physical strength and is also given with a desirable semi-permanent function. Although this method that produces excellent physical properties can protect the resulting concrete surface from weathering, its constructional procedure is rather complex and also cannot establish uniform physical properties over the entire surface when the surface is rather large. Further, it often results in unsophisticated finished surface and mortar layer may be detached from the surface.
layer thereby increasing claims against the defective construction conducted and the
cost resulted thereof.

[0011] Referring to the effects and characteristics of components of the epoxy resin
mortar composition which can be optimized by means of an ideal bonding structure
between organic and inorganic materials and their ideal mixed ratio, there are
formed voids within the crystal structure of the silica sand with high strength that
can absorb the resin. Further, when the voids are impregnated with the composition
there appear to be a high integrity resulted therefrom. In general, the increase in
physical properties can be obtained in an appropriate mixed ratio between organic
and inorganic materials.

[0012] In conventional epoxy resin composition in principle, physical properties
are optimized by mixed composition of inorganic filler, calcium carbonate, silica, talc
and limitation in size by pulverization to about 3 to about 3.5 μm. However, in a
lining agent or a coating agent which contains more than 30 parts by weight of
inorganic filler is used based on 100 parts by weight of resin, it results in
deterioration in physical properties.

[0013] Meanwhile, silica sand consisting of crystal granules having an appropriate
size of about 1 mm in diameter can exhibit excellent physical properties when the
composition is formed such that about 350 to about 400 parts by weight of silica
sand is contained as inorganic material based on 100 parts by weight of resin.
Preferred embodiments of compositions having improved strength by incorporating
an increased amount of inorganic filler into the resin have been tested in accordance
with ASTM D 695. For example, when the inorganic filler was incorporated in the
amount of about 30 parts by weight after it is pulverized based on 100 parts by
weight of resin and cured thereafter, the resulting compressed strength was 650
kg/cm². When resin mortar composition comprising about 350 to about 400 parts by
weight of silica sand with a size of about 1 mm is used as an inorganic material based on 100 parts by weight of epoxy resin and cured thereafter, the resulting compressed strength was about 900 to about 950 kg/cm² when the silica sand used was artificial one, while it was about 1,100 to about 1,200 kg/cm² when natural sand was used. Therefore, it was clear that the compressed strength resulted by the above method is about 4 to 5 times greater than that of the basic concrete.

[0014] However, when surface construction is performed via the typical complex constructional procedure even using the above composition comprising an optimized mixing ratio between the resin and silica sand it often results in unsophisticated surface and worsened physical properties because the optimal mixing ratio between the resin and the silica sand of about 100:350 to about 100:400 cannot be obtained. Therefore, the practical problems encountered in real construction sites including the cohesiveness problem between the concrete floor surface and the coating composition are described hereunder.

[0015] Resin mortar construction method comprises paving the coating composition on top of the concrete floor surface to have the thickness of about 3 to about 5 mm and press-forming plastering. In this method, if the resin content exceeds 12 parts by weight based on 100 parts by weight of mortar silica sand it has a few serious drawbacks that it cannot form a shape due to the flowability of the resin, cannot perform plastering work due to its tackiness, and also it cannot efficiently penetrate and fill in the internal voids. Further, due to the self-leveling property of the penetrating resin, it is directed to a side with a relatively lower height thus causing uniform arrangement between the resin and the silica sand and revealing the curved surface of the mortar layer as it is, which then necessitates to add additional resin to provide a flat surface to finish the construction procedure. This method is rather complex and also inefficient because it requires a lot of costly
materials. Further, the resulting surface is not sophisticated but rather crude unveiling curved surfaces thus showing the limitations in quality.

[0016] Recently, there has been introduced a method that remedies the unsophisticated state of the surface, resulted from the procedure of reinforcing by penetration after the establishment of the mortar layer, by mixing with pulverized silica sand so that the resin cannot penetrate in the course of reinforcing process thus only covering the surface layer as a finishing process. However, this method is not advantageous in that the physical properties are greatly deteriorated because internal voids are not filled in with resin while the application of this method is only limited to floor constructions. Further, the resulting unsophisticated surface prevents using of colored silica sand thus the functions and properties of mortar method are much worsened.

[0017] Further, in maintaining physical properties by forming a secondary coating layer for the purpose of attaining mechanical properties on concrete floor surface it is important to have integrity due to the affinity with the floor surface.

[0018] To date, adhesives (primers) have been used to increase cohesiveness, however, these adhesives contain solvents with a low boiling point and are thus harmful to humans and also not environment-friendly. In fact, both the chemical resin and the concrete surface having alkalinity are non-cohesive types and thus the resin can perform an adhesive function as it encompasses the internal silica sand within the concrete after penetrating the voids. However, there has been a trend of using mechanized methods due to the recent scale-up of concrete structures, which results in dense surfaces, high alkalinity and difficulty in penetration into concrete surface thus unabling to have sufficient cohesiveness. Further, decrease in cohesiveness due to unfair environmental conditions, relative humidity, water
content and inconsistency in shrinkage/expansion coefficient due to temperature difference between morning and evening are major causes of detachment.

[0019] To solve the above-mentioned problems in mortar composition and using it for surface construction, the inventors of this invention thought that the method for protecting and reinforcing concrete surface should not be considered as an optional step but an essential step, and in this regard, they found that converting the typical resin mortar composition with intermediate level of viscosity into one having a state of either a very low level of transparency or immobile opaqueness can integrate the overall constructional procedure thus remarkably reducing the complex constructional procedure and remedying the problem of revealing curved surface as well as the phenomenon that the resin is directed to a side with a relatively low height.

[0020] The inventors of this invention found that when a multi-functional primer disclosed in Korean Pat. No. 0167858 or its improved version disclosed in Korean Pat. Appl. No. 10-2002-30103, both invented by the present inventors, is coated over the concrete floor surface, cured and then used for resin mortar construction, it can greatly improve the cohesiveness between resin mortar layer and the concrete surface, which has non-cohesive property, and also enables mortar construction to be performed without using a primer on the surfaces of walls or footpaths where mechanical properties are not required thus completing this invention.

Further, in taking advantage of a machine, which can handle both paving and plastering work at the same time while allowing to shorten the construction period by means of the typical manual plastering or a finisher, the inventors of this invention also found that the paving in case of floor construction can be easily performed if a motor is attached to the spreader and also by attaching a rectangular stainless steel plastering blade with a curved surface to the front side of the spreader
a flat surface can be formed by press tamping due to its vertical movement.

SUMMARY OF THE INVENTION

[0021] Therefore, an object of the present invention is to provide a novel epoxy resin mortar composition which can greatly shorten construction period, has cost-effectiveness due to reduction in use of required materials, increases mechanical properties due to uniform arrangement of the resin and silica sand positioned inside the mortar and also provide sophisticated finished surface.

[0022] Another object of the present invention is to provide a method for resin mortar construction method using the epoxy resin mortar composition.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0023] This invention relates to a material an epoxy resin composition comprising an epoxy resin and a curing agent, which is coated on the floor surface of concrete upon mixing with silica sand, said composition comprising two separately prepared components of:

(a) 100 parts by weight of the primary component of resin comprising:

i) about 70 to about 80 wt% of epoxy basal resin;

ii) about 10 to about 20 wt% of a reactive diluent;

iii) about 1 to about 5 wt% of a non-reactive diluent;

iv) about 1 to about 5 wt% of an inorganic filler;

v) about 1 to about 4 wt% of an aggregating agent (thixo-type agent);

vi) about 1 to about 2.5 wt% of a flame retardant; and

vii) about 0.05 to about 0.1 wt% of a defoamer,

and

(b) about 30 to about 50 parts by weight of the secondary component of a curing agent comprising:
i) about 30 to about 60 wt% of aliphatic amine;

ii) about 20 to about 40 wt% of an exchangeable reaction accelerator;

iii) about 5 to about 20 wt% of a primary alicyclic amine;

iv) about 5 to about 15 wt% of an accelerator; and

v) about 1 to about 8 wt% of an adducting agent.

[0024] The epoxy resin composition of the present invention comprises 100 parts by weight of a low-viscous resin component, which prevents it from being flowed or directed to a side while it is being mixed with silica sand, and about 30 to about 50 parts by weight of a curing agent, which is mixed with the resin component at the construction site. The above resin composition has a lower viscosity compared to that of the typical resin composition and thus can contribute to the preparation of an immobile resin composition, and the resin mortar composition resulted by mixing this immobile epoxy resin composition with silica sand can be used to perform construction on the surfaces of concrete floor or walls.

[0025] The present invention is described in greater detail as set forth hereunder.

[0026] This invention relates to an epoxy resin composition comprising an epoxy resin and a curing agent, which is coated on the floor surface of concrete upon mixing with silica sand, said composition comprising two separately prepared components of:

(a) 100 parts by weight of the primary component of resin comprising:

i) about 70 to about 80 wt% of epoxy basal resin;

ii) about 10 to about 20 wt% of a neoglycidyl monomeric reactive diluent;

iii) about 1 to about 5 wt% of at least one non-reactive diluent selected from the group consisting of ethyl cellosolv and xylene;

iv) about 1 to about 5 wt% of an inorganic filler;

v) about 1 to about 4 wt% of silicone dioxide as an aggregating agent;

vi) about 1 to about 2.5 wt% of pentabromodiphenyloxide as a flame retardant;
and

vii) about 0.05 to about 0.1 wt% of polysiloxane as a defoamer,

and

(b) about 30 to about 50 parts by weight of the secondary component of a curing agent comprising:

i) about 30 to about 60 wt% of polyoxypropylene amine;
ii) about 20 to about 40 wt% of phenylamine exchangeable reaction accelerator;
iii) about 5 to about 20 wt% of triethylene tetraamine or ethylene triamine;
iv) about 5 to about 15 wt% of a phenyl accelerator; and
v) about 1 to about 8 wt% of an epoxy adducting agent.

[0027] In preparing the above composition, a low-viscous monomer or an aggregating agent having an epoxy group can be used in addition to the above reactive diluent. Examples of the diluents that can be used in this invention are neocid glycidyl ether, phenylglycidyl ether, butylglycidyl ether, and alipatic 3 functional epoxy.

[0028] Examples of aggregators are silicone dioxide and pulverized Chop Abestos (RG-244®) or Garamite thixotropic agent (BYK Co., Ltd., Germany). However, asbestos itself is a carcinogenic material and is thus prohibited to be used. Garamite thixotropic agent can be used in preparing some opaque resin compositions.

[0029] A non-reactive diluent can be added less than 3% based on 100 parts by weight of the basal resin. However, solvents with low boiling point such as MK and acetone may not be used in mortar composition with formability because it inhibits curing process even when it is added in small amount. In addition, solvents with intermediate or high boiling point such as butyl cellosolv, alcohol, MYBK, and cyclohexane may be used in the range of about less than 3%.

[0030] The epoxy resin composition of the present invention comprises a basal epoxy resin, a reactive diluent (monomer), a non-reactive diluent, an aggregating
agent, an inorganic filler, a flame retardant, a defoamer, color base, a curing agent, a curing accelerator and the like. The special feature of the epoxy resin composition of the present invention lies in that, unlike the typical composition, it is rendered immobile by being mixed and substituted with a curing agent at a flowable state of having a very low viscosity.

[0031] The resin composition of the present invention is provided with two separate components comprising:

(a) a resin component which is prepared by

   (i) mixing basal epoxy resin with a reactive diluent and a non-reactive diluent to reduce tackiness;

   (ii) mixing the resulting mixture with an exchangeable aggregating agent; and

   (iii) allowing the resulting mixture to have an immobility in case a curing agent comprising a primary alicyclic amine is added, and then mixed with a defoamer;

and

(b) a curing agent which comprises:

   (i) a reaction accelerator which is exchangeable with alicyclic- and aliphatic amines;

   (ii) a curing accelerator; and

   (iii) an adducting agent.

[0032] The above prepared two separate components of the resin composition are mixed on-site, which is further added with silica sand to prepare a resin mortar composition to be used for resin mortar construction.

[0033] When an opaque composition is required for a certain use, an inorganic filler can be further added.

[0034] The inventors of this invention have performed numerous tests on workability and physical properties of the composition of this invention to be
suitable for mortar construction method and succeeded in reducing the construction procedure from the original 8 steps to 4 steps. Further, In cases of performing constructions on surfaces for foot paths, walls, stairways, hallways or the one for using colored silica sand, all of which do not require mechanical properties, the constructional steps were reduced to 2 to 3 steps. Still further, the composition of this invention was shown to have various advantages: enabling to reduce constructional steps; attaining improved strength and well-sophisticated finished surfaces; and providing conveniences in machine-employing work.

[0035] According to this invention, when two separately prepared components of a resin composition comprising a resin component which comprises epoxy basal resin with intermediate level of liquid, a reactive diluent, a non-reactive diluent, an aggregating agent, a flame retardant, and a defoamer and a curing composition which comprises a curing agent, an exchangeable reaction accelerator, primary alicyclic amine, a curing accelerator, and an adducting agent, are combined according to a predetermined mixing ratio at construction site it is possible to obtain a resin composition at immobilized state with reduced tackiness and lower specific gravity.

[0036] Preferred embodiments regarding contents of each component of the composition of the present invention are described hereunder.

[0037] In a preferred embodiment of the present invention, the resin component, the first component of the composition, is prepared as follows: i) heating epoxy basal resin for about 30 min at 80 °C, ii) adding the resultant into a mixing tank, wherein a reactive diluent and a non-reactive diluent are added and mixed therein at a high speed for about 30 min, iii) adding with an exchangeable aggregating agent, a flame retardant, a filler, and a defoamer to the above mixture and mixing the resultant thereof, iv) performing press milling using a 3 bon roller (inorganic filler is not added if a transparent resin composition is required), and v) removing foams by means of a defoaming device.
[0038] In a preferred embodiment of the present invention, the curing component, the second component of the composition, is prepared as follows: i) adding aliphatic amine, alicyclic amine, and an exchangeable reaction accelerator into a reaction tank and mixing therein, ii) heating the mixture at 40 °C and slowly mixing, and iii) adding further with alicyclic amine.

[0039] Thus prepared two liquid type of components of the resin component and the curing component of the epoxy resin composition is preferred that about 30 to about 50 parts by weight of a curing component is mixed at the construction site with 100 parts by weight of the resin component. The above mixing ratio was obtained based on the results of numerous experiments and on-site applications of testing various ratios between the resin component and the curing component. If the content of the curing component exceeds the above content the immobility of the resulting composition may not be obtained while physical and mechanical properties of the composition will be also deteriorated thus unabling to serve its functional role. In fact, only the composition prepared according to the above recommended mixing ratio between the two components can be allowed to become immobile not having the typical tackiness, thereby improving its dimorphism and formability with lowered specific gravity by subsequently on-site mixing with silica sand at the construction site, and also enabling the mortar construction which can be applied to surfaces of concrete floor, walls, curved sites and the like.

[0040] A pigment can be further added in preparing the composition of the present invention in addition to the aforementioned components. A pigment can be added considering the specific gravity or occultating capability of a selected pigment, and generally used in the range of about 1 to 30 parts by weight based on 100 parts by weight of the resin component.

[0041] As stated above, the resin composition of the present invention having two separately prepared liquid components can rather freely control its mobility and thus can be suitably applied to the surfaces of concrete floors, walls, slopes and
curves. More specifically, it is preferably to use about 30 parts by weight of epoxy resin composition based on 100 parts by weight of silica sand. When applying the above epoxy resin composition with the above-mentioned mixing ratio to resin mortar construction, all voids in the construction layer are filled up with the resin component thereby drastically reducing the construction period, improving physical properties and aesthetic beauty.

[0042] In a further embodiment of the present invention, there is provided with a construction method using the epoxy resin composition according to the present invention. Although the mortar construction method of the present invention is in principle similar to the conventional ones. However, the method of the present invention differs greatly from the conventional ones in that it uses a specially prepared composition and a primer as state above, and also that it enables to use a machine. The method of the present invention can be applied in varied ways.

[0043] In particular, the present invention provides a method for conducting surface construction using mortar to form a mortar layer on a concrete surface requiring mechanical properties by mixing epoxy resin and silica sand comprising:
(a) shot blasting of concrete floor surface to remove irregulars and laitans;
(b) coating multifunctional primer adhesive on top of the concrete floor surface;
(c) mixing the epoxy resin composition, comprising epoxy resin and a curing agent, with silica sand; and forming a mortar layer by plastering on top of the resulting surface thereof; and
(d) coating said epoxy resin composition, comprising epoxy resin and a curing agent, on top of the resulting surface thereof to form a finished layer.

[0044] In a preferred embodiment, the present invention provides a method for conducting surface construction using mortar to form a mortar layer on a concrete surface requiring mechanical properties by mixing epoxy resin and silica sand comprising:
(a) shot blasting of concrete floor surface to remove irregulars and laitans;
(b) coating multifunctional primer adhesive on top of the concrete floor surface;
(c) scrapping epoxy resin composition, comprising epoxy resin and a curing agent, on top of the resulting surface thereof; and at the same time mixing the epoxy resin composition, comprising epoxy resin and a curing agent, with silica sand and forming a mortar layer on top of the resulting surface thereof; and
(d) coating the epoxy resin composition, comprising epoxy resin and a curing agent, on top of the resulting surface thereof to form a finished layer.

[0045] In another preferred embodiment, the present invention provides a method for conducting surface construction using mortar to form a mortar layer on a concrete surface not requiring mechanical properties by mixing epoxy resin and silica sand comprising:

(a) shot blasting of concrete floor surface to remove irregulars and laitans; and
(b) mixing the epoxy resin composition, comprising epoxy resin and a curing agent, with silica sand; and forming a mortar layer by plastering on top of the resulting surface thereof.

[0046] In a more preferred embodiment, the present invention provides a method for conducting surface construction using mortar to form a mortar layer on a concrete surface not requiring mechanical properties by mixing epoxy resin and silica sand comprising:

(a) shot blasting of concrete floor surface to remove irregulars and laitans; and
(b) scrapping epoxy resin composition, comprising epoxy resin and a curing agent, on top of the resulting surface thereof; and at the same time mixing the epoxy resin composition, comprising epoxy resin and a curing agent, with silica sand and forming a mortar layer on top of the resulting surface thereof.
[0047] This finishing layer to be coated on top of the mortar layer formed by the mortar construction according to the present invention can be applied in the form of either transparent or colored opaque embossing upon necessity.

[0048] In a further embodiment, the present invention relates to a construction method for concrete surface wherein the voids between silica sands on the mortar surface, press-forming plastered on the concrete surface, are filled up with resin.

[0049] In applying the epoxy resin composition, a multi-functional primer adhesive is coated where mechanical properties are required prior to forming a mortar layer over the concrete surface by using the resin mortar composition. The multi-functional type primer used in the present invention is preferably a water soluble 3 component multi-functional primer adhesive. For example, the multi-functional primer adhesive disclosed in Korean Pat. Appl. No. 10-2002-0030103 by the present inventors is preferable.

[0050] In a preferred embodiment, the present invention provides a multi-functional primer adhesive comprising three components of:

(a) 100 parts by weight of resin component comprising:
   i) about 40 to about 50 wt% of epoxy basal resin;
   ii) about 25 to about 35 wt% of at least one non-reactive diluent selected from the group consisting of ethyl cellosolve, butanol and xylene;
   iii) about 2 to about 4 wt% of E-EPO emulsifier (Cell Chemical Co., Ltd., Korea);
   iv) about 1 to about 3 wt% of a silicon dioxide aggregating agent;
   v) about 0.01 to about 0.1 wt% of a polysiloxane defoamer; and
   vi) about 20 to about 35 wt% of water

(b) about 30 to about 40 parts by weight of a curing agent comprising:
   i) about 60 to about 70 wt% of amine-based curing agent;
   ii) about 1 to about 10 wt% of an phenol-based accelerator; and
   iii) about 20 to about 35 wt% of ethyl cellosolve; and

(c) about 50 to about 100 parts by weight of a filler component comprising:
i) about 80 to about 95 wt% of cement;
ii) about 1 to about 10 wt% of alumina; and
iii) about 10 to about 10 wt% of calcium hydroxide.

[0051] In addition, the present invention relates to a resin mortar composition comprising an epoxy resin and a curing composition, the mixture of which is combined later with silica sand, wherein the above epoxy resin component is used about 20 to about 50 parts by weight based on 100 parts by weight of artificial- or natural silica sand, preferably about 27 to about 33 parts by weight of the epoxy resin component. If the resin content is less than the above content there will be formed voids as in the typical composition thus reducing physical properties. If it exceeds the above range it will result in poor workability and unsophisticated construction structure because it will require additional construction step of filling in voids.

[0052] The mortar construction method of the present invention is described in a greater detail herein. The mortar construction method of the present invention is to reinforce the concrete surface using the epoxy resin composition while providing a flooring material. More specifically, the above method comprises: a) shot blasting of floor surfaces including of floors compacted by means of a finisher after spreading concrete, typical color hardener floors, plastered floors after spreading with concrete, and other concrete structures; b) coating the multi-functional primer adhesive as stated above to have a thickness of about 0.1 to about 0.2 mm followed by curing; c) the immobile epoxy resin composition of the present invention is mixed with silica sand and then spread on top of the above primer layer, wherein about 200 to about 500 parts by weight of silica sand with a size of about 0.3 to about 2 mm is used based on 100 parts by weight of the epoxy resin composition, preferably about 350 to about 400 parts by weight. Here, the floor surface can be coated to have a thickness
of from about 1 mm or above, and walls or ceilings can be coated to have a thickness of from about 10 mm.

[0053] Compared to the typical mortar constructions, the mortar construction method of the present invention has the advantages that it provides an easy plastering because the composition is not tacky, and also provides a well sophisticated finished surface without leaving any voids on the cured surface thereby attaining excellent physical properties and external surfaces with aesthetic beauty.

An automated plastering process can be applied in the present invention for the purpose of providing conveniences in mortar construction which comprises: coating a primer on floors as well as parts where mechanical properties are required and curing; preparing the resin mortar composition of the present invention by mixing the epoxy resin composition with silica sand by using a mixer; and performing paving and pressed plastering simultaneously using a machine. The automated plastering process is described in detail herein. The epoxy resin composition of the present invention is mixed with silica sand sufficiently in a mixing agitator according to a predetermined ratio and then the mixture is transported to a spreader in a plastering machine where it is allowed to move forwardly upon operation of the machine, during which the resin mortar composition is being pushed downwardly at the lower part of the spreader and automatically paved with a certain thickness, which is under appropriate control. More specifically, there is provided a plastering blade with an oval shape, which is provided on the rear side of the spreader, to form a flat surface by press tamping due to its vertical movement. Further, it can be applied to a construction method using a manual plastering or a finisher and the construction is completed via a procedure consisting of 4 steps. For places such as stairways, hallways and walls, where a machine cannot be used, a trowel may be used. For parts where mechanical properties are not required the construction procedure can be reduced to 1 or 2 steps.
[0054] The immobile epoxy resin composition of the present invention is described herein regarding its functions and effects.

[0055] The typical resin used in the resin mortar construction is self-leveling using its natural flowability. Therefore, in performing plastering work, silica sand and resin had to be mixed in the parts by weight ratio of 100:10. However, there were formed voids after the plastering work and the voids had to be filled up later. This is because the mortar layer cannot maintain its shape if resin content is higher than the above ratio due to the flowability of the resin. Further, because the resin is tacky it readily adheres to the plastering blade thus unabling to perform the plastering work. That is, the traditional mortar construction method has the workability by maintaining the mortar layer with the above mixing ratio of 100:10 between the silica sand and the resin, it cannot serve its original mechanical functions due to the voids being remained within the mortar after the plastering work and is also easily contaminated. Therefore, the voids are filled up with the resin. When the voids are filled up with the resin the resin is allowed to form a flat surface and there are also exposed mortar layers with relatively high and low heights. If the filling-up process is proceeded based mainly on the surfaces with relatively high height the process becomes rather complicated and also desirable surface is hard to obtain.

[0056] The total resin content to be used in the overall process is about 25 to about 35 parts by weight based on 100 parts by weight of silica sand. Although the above mixing ratio provides excellent physical properties, the resin cannot penetrate evenly into the interior of the mortar layer. Further, in curved parts where resin is accumulated it is not possible to obtain a uniform arrangement of resin and silica sand, and thus requires a large amount of additional resin to cover the exposed curved parts. In addition, it has a few other drawbacks that the overall physical properties are not uniform; the finished surface is not sophisticated; construction using colored silica sand is not possible, and its process is very complicated with many steps thus being not cost-effective.
[0057] In the resin mortar construction method using the immobile epoxy resin composition of the present invention, about 20 to about 50 parts by weight of resin (epoxy resin composition) can be mixed instantly with 100 parts by weight of silica sand due to the immobility of the epoxy resin composition. The resin is not flowed or dispersed around during the press-forming plastering work resulted from a mixing of a large amount of resin but it rather increases the integrity with silica sand and maintains desirable surface shapes at curved or sloped surfaces.

[0058] Further, the resin content of about 20 to about 50 parts by weight based on 100 parts by weight of silica sand refers to the entire resin content including the resin content used for reinforcing step as well as the resin content for forming a mortar layer in the traditional resin mortar construction. That is, the resin mortar construction method of the present invention performs the press-forming plastering using only once the entire resin content used from the initial plastering process to the very end finishing process thereby providing excellent physical properties having a uniform resin arrangement and a mortar layer without generating voids.

[0059] As stated, the present invention reduces procedural steps by using an immobile epoxy resin composition. Unlike the conventional resin mortar construction method comprising 1)shot blasting of concrete floor(base), 2)primer coating, 3)scraping, 4)coating of mortar, 5)press-forming plaster using a finisher, 6)reinforcing by penetration, 7)intermediate coating, and 8)top coating & finish coating, the present invention, in case of using colored silica sand, comprises: 1)shot blasting of concrete floor(base), 2)primer coating, 3)coating of resin mortar composition, and 4)top coating, while the present invention, in case of performing construction where mechanical properties are not required, can be performed without primer coating comprising 2 steps of 1)shot blasting of concrete floor(base) and coating of resin mortar composition, where the construction is completed with plastering work upon coating of resin mortar.
[0060] In the resin mortar construction method of the present invention regarding forming of a mortar layer it includes both a method wherein the mortar layer is formed while performing scapping using the epoxy resin mortar and a method wherein mortar layer is formed without performing scapping. However, it is preferable to have a scapping process.

[0061] In the resin mortar construction method of the present invention on floor surfaces using a finisher, the entire construction process can be reduced to the same level and a plastering machine which enables both paving as well as a pressed-forming plastering developed by the present invention thereby providing conveniences and cost reduction.

Further, in the resin mortar construction method using a machine in the present invention, the following features are especially noticeable. That is, scapping is performed using an air sprayer installed on the front side in the lower part of the container for resin mortar composition, wherein the spreader is equipped with a motor for providing automatic movements in forward and backward directions. Further, the resin mortar composition is being pushed down through the lower part of the container and the rectangular stainless steel blade with curved parts, installed at the rear side of the spreader, contributes to form a flat surface by press tamping due to its vertical movement.

[0062] As stated above, the surface construction method of the present invention comprises: initial coating of the multi-functional primer (adhesive) on concrete floor surface, wherein the primer is invented by the present inventor and disclosed in Korean Pat. Appl. No. 10-2002-0016876; formation of a mortar layer on top of the concrete floor surface by suing a resin mortar composition, a mixture between the immobile epoxy resin composition and silica sand; and manual pressed-forming plastering using a trowel or a machine, which has improved workability and is also cost effective capable of various concrete surface constructions.
[0063] This invention is explained in more detail based on the following Examples however they should not be construed as limiting the scope of this invention.

Examples

5

[0064] Example 1

1. Preparation of Resin Component (primary composition)

<table>
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<tr>
<th>Component</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Epoxy basal resin (1)</td>
<td>37.700 g</td>
</tr>
<tr>
<td>Epoxy basal resin (2)</td>
<td>37.700 g</td>
</tr>
<tr>
<td>Reactive diluent (3)</td>
<td>16.856 g</td>
</tr>
<tr>
<td>Non-reactive diluent (4)</td>
<td>1.880 g</td>
</tr>
<tr>
<td>Non-reactive diluent (6)</td>
<td>1.130 g</td>
</tr>
<tr>
<td>Aggregating agent (7)</td>
<td>3.770 g</td>
</tr>
<tr>
<td>Flame retardant (8)</td>
<td>1.880 g</td>
</tr>
<tr>
<td>Defoamer (9)</td>
<td>0.084 g</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.000 g</strong></td>
</tr>
</tbody>
</table>

2. Preparation of Curing Component (secondary composition)

<table>
<thead>
<tr>
<th>Component</th>
<th>Amount</th>
</tr>
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<tbody>
<tr>
<td>Curing agent (10)</td>
<td>17.47 g</td>
</tr>
<tr>
<td>Curing accelerator (11)</td>
<td>11.65 g</td>
</tr>
<tr>
<td>Curing agent (12)</td>
<td>5.49 g</td>
</tr>
<tr>
<td>Adducting agent (13)</td>
<td>1.94 g</td>
</tr>
<tr>
<td>Curing accelerator (14)</td>
<td>3.43 g</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>40.00 g</strong></td>
</tr>
</tbody>
</table>

The above compositions are mixed at construction site so that an epoxy resin composition is prepared by mixing the resin composition (primary composition) and the curing composition (secondary composition) in the ratio of
weight parts of 100:40, and then the epoxy resin composition is mixed again with silica sand in the ratio of weight parts of 100:350. The resulting resin mortar resin was then used in mortar construction method for concrete floor surface. Because this composition has a relatively high resin content the construction process in pressed-forming plastering was proceeded well without being flowed around or disrupted of its shape.

[0065] The detailed information on the components including their manufacturers are as follows:

1. Epoxy basal resin: (copolymer of epichlorohydrin and bisphenol) in liquid state (Kukdo Chemical Co., Ltd., Korea)
2. Epoxy basal resin: (copolymer of epichlorohydrin and bisphenol) containing chlorine in liquid state (Kukdo Chemical Co., Ltd., Korea)
4. Non-reactive diluent: ethyl cellosolv - Ethylene glycol monoethylene ether acetaea (Union Co., Ltd., USA)
5. Non-reactive diluent: xylene (LG-CALTEX Oil Corporation, Korea)
6. Aggregating agent: Silicon oxide (Degussa Co., Ltd., Germany)
7. Flame retardant: pentabromo diphenyl oxide (Grade lakers Co., Ltd., USA)
8. Defoamer: polysiloxane (BYK Co., Germany)
9. Curing agent: polypropylene amine (Texaco Co., Ltd., USA)
10. Curing agent: phenol aniline (Mitsui Dowasu, Japan)
11. Curing agent: triethylene tetraamine (Mitsui Dowasu, Japan)
12. Epoxy basal resin: (Kukdo Chemical Co., Ltd., Korea)
13. Phenol: not adductd (Korea Kumho Petrochemical Co., Ltd., Korea)

[0066] Experimental Example 1

After shot blasting, concrete floor surfaces were coated with the epoxy multi-
functional primer (Korea Pat. Appl. No. 10-2002-0016876, an improved invention of a previous Korea Pat. Appl. No. 10-2002-0016876) shown in Example 1, which greatly improved the functions and properties of the previous version of primer adhesive (MNA) invented by the inventors of the present invention disclosed in Korea Pat. No. 0167858, evaluated as an excellent product by Korea Research Institute of Chemical Technology (KRICT); and then mixed with the primary and secondary compositions in the weight parts ratio of 100:40. In the meantime, artificial- and natural silica sand having a thickness of 1 mm in diameter were prepared 100 parts by weight, respectively, and added with 30 parts by weight of the above mixed epoxy resin composition thereto, and then press-plastered on the above concrete surfaces with a thickness of 5 mm followed by finish coating with a thickness of less than 0.5 mm. Tests performed after 72 hours thereafter showed that it has excellent physical properties: cohesiveness (adhesiveness) (39 kgf/cm²); compressed strength of artificial silica sand (950-1,100 kgf/cm²), natural silica sand (1,200-1,300 kgf/cm²), and tensile strength (950-1,100 kgf/cm²).

As expected from the above results, when the resin composition prepared according to the present invention was mixed at construction site, the resin was not flowed around or disrupted of its shape and sophisticated surfaces were formed as a result. Further, the simplified constructional procedure provided conveniences and also very effective as a flooring material due to its superior physical properties in adhesiveness.

[0067] Experimental Example 2

The composition in Experimental Example 1 was tested in a laboratory according to KS F5000:1990 Standard to compare its results with those obtained by testing the composition on floor surfaces of a concrete structure. Concrete specimen to be tested was prepared to have a size of 1200x1200x200 mm and cured for 28 days at 20°C and then shot blasted the surfaces such as laitans via grindings and
compressed strength was measured at three conditions of air dry condition, wet
condition and surface dry saturation condition in accordance with ASTM D
4541:1985 for measurement of cohesiveness, JIS K 6911 for tensile strength and
ASTM D 695 for compressed strength. Twelve hours after coating the multi-
functional primer of the above composition at 20°C, 100 weight parts of the primary
composition were mixed with 40 weight parts of the secondary composition to
obtain an epoxy resin composition. Then, 100 weight parts of silica sand were mixed
with 30 weight parts of the above epoxy resin composition, and the mixture was
press-plastered on the cured primer layer to have the thickness of 5 mm. Then, the
above epoxy resin composition was coated thereto to have the thickness of 0.5 mm
the physical properties of surfaces at air dry condition after a period of 24 hours at
20°C. The results were as follows: surface cohesiveness (35 kgf/cm²); surface dry
saturation state (39.2 kgf/cm²), and wet state (37.7 kgf/cm²). In additional tests
using a different specimen prepared according to a different Standard, the results
were as follows: tensile strength of artificial silica sand (470 kgf/cm²), compressed
strength of artificial silica sand (1,100 kgf/cm²), and tensile strength of natural silica
sand (1,250 kgf/cm²).

[0068] As shown in the above Experimental Examples 1-2, the resin mortar
construction method of the present invention using immobile epoxy resin
composition showed superior physical properties as a flooring material.

[0069] As stated above, the epoxy resin composition of the present invention
comprises of two separately prepared compositions of a resin composition and a
curing agent composition; wherein the resin composition comprises a basal epoxy
resin, a reactive diluent, a non-reactive diluent, an aggregating agent, a flame
retardant, and a defoamer, and the curing agent composition comprises polyamine,
polypropylene amine, triethylene tetraamine, phenylaniline, phenol accelerator
without any added agent, alicyclic compound, and other components as curing
components. Unlike the typical resin composition, the epoxy resin composition of the present invention is rendered immobile with low viscosity, which can provide improved external appearance with sophisticated finishes, reduce constructional period and cost effectiveness when it is used as a coating material in mortar construction for concrete floor surfaces.

[0070] In particular, the construction method of the present invention can employ a machine in case of a floor construction thus reducing construction period and provide cost-effective construction.

[0071] Further, the present invention employs a multi-functional primer as an adhesive in mortar construction which is environment-friendly and also has a relatively high affinity for concrete surfaces having alkalinity thereby greatly improving physical properties of the resulting structure.

[0072] The invention has been described in detail with reference to preferred embodiments thereof. However, it will be appreciated that those skilled in the art, upon consideration of the disclosure, may make modifications and improvements within the scope and spirit of the invention.
WHAT IS CLAIMED IS:

1. An epoxy resin composition comprising an epoxy resin and a curing agent, which is coated on the floor surface of concrete upon mixing with silica sand, said composition comprising two separately prepared components of:
   (a) 100 parts by weight of the primary component of resin comprising:
      i) about 70 to about 80 wt% of epoxy basal resin;
      ii) about 10 to about 20 wt% of a reactive diluent;
      iii) about 1 to about 5 wt% of a non-reactive diluent;
   iv) about 1 to about 5 wt% of an inorganic filler;
   v) about 1 to about 4 wt% of an aggregating agent;
   vi) about 1 to about 2.5 wt% of a flame retardant; and
   vii) about 0.05 to about 0.1 wt% of a defoamer, and
   (b) about 30 to about 50 parts by weight of the secondary component of a curing agent comprising:
      i) about 30 to about 60 wt% of aliphatic amine;
      ii) about 20 to about 40 wt% of an exchangeable reaction accelerator;
      iii) about 5 to about 20 wt% of a primary alicyclic amine;
   iv) about 5 to about 15 wt% of an accelerator;
   v) about 1 to about 8 wt% of an adducting agent.

2. The epoxy resin composition in claim 1, wherein said composition further comprises about 1 to about 30 parts by weight of a pigment based on 100 parts by weight of the primary composition of resin.

3. The epoxy resin composition in claim 1, wherein said composition employs glycidylether of a low-viscous monomer having an epoxy group as a reactive diluent,
Chop Asbestos (RG-244®) or Garamite thixotropic agent as an aggregating agent.

4. The epoxy resin composition in claim 1, wherein said inorganic filler comprises an inorganic substance selected from the group consisting of silica, calcium carbonate, and talc in case said composition takes on an opaque color.

5. The epoxy resin composition in claim 1, wherein, in the course of press plastering, about 20 to about 50 parts by weight of said epoxy resin composition is added to be mixed based on 100 parts by weight of silica selected from artificial-, natural- and color silica sand.

6. A method for conducting surface construction using mortar to form a mortar layer on a concrete surface by mixing epoxy resin and silica sand comprising:
   (a) shot blasting of concrete floor surface to remove irregulars and laitans;
   (b) coating multifunctional primer adhesive on top of said concrete floor surface;
   (c) mixing the epoxy resin composition, comprising epoxy resin and a curing agent, with silica sand; and forming a mortar layer by plastering on top of the resulting surface thereof; and
   (d) coating said epoxy resin composition, comprising epoxy resin and a curing agent, on top of the resulting surface thereof to form a finished layer.

7. A method for conducting surface construction using mortar to form a mortar layer on a concrete surface by mixing epoxy resin and silica sand comprising:
   (a) shot blasting of concrete floor surface to remove irregulars and laitans;
   (b) coating multifunctional primer adhesive on top of said concrete floor surface;
   (c) scrapping epoxy resin composition, comprising epoxy resin and a curing agent, on top of the resulting surface thereof; and at the same time mixing the epoxy resin composition, comprising epoxy resin and a curing agent, with silica sand and
forming a mortar layer on top of the resulting surface thereof; and
(d) coating said epoxy resin composition, comprising epoxy resin and a curing agent, on top of the resulting surface thereof to form a finished layer.

8. A method for conducting surface construction using mortar to form a mortar layer on a concrete surface by mixing epoxy resin and silica sand comprising:
(a) shot blasting of concrete floor surface to remove irregulars and laitans; and
(b) mixing the epoxy resin composition, comprising epoxy resin and a curing agent, with silica sand; and forming a mortar layer by plastering on top of the resulting surface thereof.

9. A method for conducting surface construction using mortar to form a mortar layer on a concrete surface by mixing epoxy resin and silica sand comprising:
(a) shot blasting of concrete floor surface to remove irregulars and laitans; and
(b) scrapping epoxy resin composition, comprising epoxy resin and a curing agent, on top of the resulting surface thereof; and at the same time mixing the epoxy resin composition, comprising epoxy resin and a curing agent, with silica sand and forming a mortar layer on top of the resulting surface thereof.

10. In claims 6-9, said surface construction is characterized in that paving is performed using a conventional means such as manual plastering or using a finisher or other plastering devices available and then the voids present in between silica sand on press plastered mortar surface are filled with resin.

11. In claims 6-9, said epoxy resin composition comprising epoxy resin and a curing agent is the same as in claim 1.

12. In claims 6-9, said multi-functional primer adhesive comprises three separately
prepared components of:
(a) 100 parts by weight of resin component comprising:
   i) about 40 to about 50 wt% of epoxy basal resin;
   ii) about 25 to about 35 wt% of at least one non-reactive diluent selected from the
      group consisting of ethyl cellosolve, butanol and xylene;
   iii) about 2 to about 4 wt% of E-EPO emulsifier;
   iv) about 1 to about 3 wt% of a silicon dioxide aggregating agent;
   v) about 0.01 to about 0.1 wt% of a polysiloxane defoamer; and
   vi) about 20 to about 35 wt% of water
(b) about 30 to about 40 parts by weight of a curing agent comprising:
   i) about 60 to about 70 wt% of amine-based curing agent;
   ii) about 1 to about 10 wt% of at phenol-based accelerator; and
   iii) about 20 to about 35 wt% of ethyl cellosolve; and
(c) about 50 to about 100 parts by weight of a filler component comprising:
   i) about 80 to about 95 wt% of cement;
   ii) about 1 to about 10 wt% of alumina; and
   iii) about 10 to about 10 wt% of calcium hydroxide.

13. A method for conducting surface construction using mortar to form a mortar
    layer on a concrete surface by using a machine, wherein said machine comprising:
    (a) a spreader which is equipped with a motor to perform an automatic movement
        in both forward and backward directions;
    (b) an air sprayer which is attached to the floor side of the container for resin mortar
        composition to perform scrapping, and through the floor of said container resin
        mortar composition is being pushed down while it is being mixed; and
    (c) a rectangular stainless steel plastering blade with a curved surface, which is
        provided on the front side of said spreader, to form a flat surface by press tamping
        due to its vertical movement.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 C08L 63/00, C09D 163/00, C09D 7/12, C04B 26/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 C08L 63/00, C09D 163/00, C09D 7/12, C04B 26/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Patents and applications for inventions since 1975

Japanese Utility models and application for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

KIPASS, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>A</td>
<td>KR 2000-47284 A (Korea Chemical Co., Ltd.) 25 July 2000 See the whole document</td>
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<td>A</td>
<td>US 4,189,414 A (Kowa Chemical Industry LTD.) 19 February 1980 See the whole document</td>
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<td>A</td>
<td>JP 15-12893 A (Toray Ind. Inc.) 15 January 2003 See the whole document</td>
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<td>A</td>
<td>KR 1997-6215 A (Hwa Sung Industrial Co., Ltd.) 19 February 1997 See the whole document</td>
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☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

18 APRIL 2005 (18.04.2005)

Date of mailing of the international search report


Name and mailing address of the ISA/KR

Korean Intellectual Property Office
920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

HONG, SUNG RAN

Telephone No. 82-42-481-8146

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