

Description

MEMBER FOR FIXING STATIONARY ELEMENT AND ITS PRODUCTION PROCESS

TECHNICAL FIELD

The present invention relates to a member for fixing a stationary element such as an anchor rib. More particularly, the invention relates to a composite of a radical-hardening type resin and a hardening agent, which is used to fix a stationary element used in post-bonding a stationary element such as a bolt, a deformed bar, or other insert hardware to a base material such as concrete.

BACKGROUND ART

In general, the following method is carried out to fix a stationary element, such as a bolt or a deformed bar, to a concrete wall or the like. Essentially, a given hole is formed with a drill in a base material, a capsule containing an adhesive is inserted into the hole, a bolt or the like is embedded by applying an impact with an embedding machine while rotating the bolt or the like, and simultaneously, the capsule is crushed causing a flowing out and hardening of the adhesive in the hole, thereby fixing the bolt to the hole.

A fixing agent used for fixing such a stationary element is generally constituted of a radical-hardening type resin and a hardening agent, which are in a mutually isolated state encapsulated in a capsule-shaped container made of glass or a synthetic resin.

The container is broken when embedding the bolt. As a result, the radical-hardening type resin and the hardening agent are mixed. To form such isolated states of the resin and the hardening agent in the capsule, the following procedure has conventionally been employed. A container is made with a double structure. Then, the inner container is filled with a hardening agent and the outer container is filled with a hardening type resin, aggregates, and the like. The following procedure has also conventionally been employed. A hardening agent is molded into a rod shape, a granular shape, or the like. This molded product is loaded into a capsule. And the capsule is then filled with a radical-hardening type resin.

However, regarding the case of a container having a double structure, container cost and workability when filling an inner container with a hardening agent are poor. Further, regarding the case where a hardening agent is molded into a rod shape or the like, there is the problem concerning the efficiency of the step involving filling a container with aggregates. Furthermore, even when a hardening agent is molded into a granular shape, it is still difficult to achieve a good level of efficiency for the filling step in capsule production. In addition to this, problems concerning the subsequent breaking ability and mixing ability are not sufficiently resolved.

DISCLOSURE OF THE INVENTION

Accordingly, one object of the present invention is to provide

a member for fixing a stationary element which is capable of eliminating structural elements unnecessary for the actual fixing of the stationary element, by providing a novel composite form of a radical-hardening type resin and a hardening agent. Another object of the present invention is to provide a member for fixing a stationary element which can simplify the production steps of the member for fixing a stationary element.

The inventors of the present invention have made investigations of a novel composite form and have found that the above-mentioned conventional problems can be solved by making an unhardened radical-hardening type resin into a solid unit having a given shape. The present invention has been completed based upon this finding.

According to the present invention, the following means are provided.

(1) A member for fixing a stationary element, including:

a core portion containing an unhardened radical-hardening type resin; and

a hardening agent phase constituting at least a part of a surface layer side of the core portion, and containing a hardening agent for the radical-hardening type resin,

in which the inner phase containing the unhardened radical-hardening type resin of the core portion has a viscosity of 10 Pa·s or more and 200 Pa·s or less at 20°C.

(2) A member for fixing a stationary element, including:

a core portion containing an unhardened radical-hardening type resin; and

a hardening agent phase constituting at least a part of a surface layer side of the core portion, and containing a hardening agent for the radical-hardening type resin,

in which the inner phase containing the unhardened radical-hardening type resin of the core portion has a thixotropy coefficient of 1.1 or more and 5.0 or less.

(3) The member for fixing a stationary element according to (2), in which at least one of the core portion and the hardening agent phase contains aggregate.

(4) A member for fixing a stationary element, including:

a core portion containing an unhardened radical-hardening type resin;

a hardening agent phase constituting at least a part of a surface layer side of the core portion, and containing a hardening agent for the radical-hardening type resin; and

a division portion provided so as to be capable of forming at least two divided bodies each having the core portion and the hardening agent phase.

(5) A production process of a member for fixing a stationary element, including the step of:

(a) applying a hardening agent for a radical-hardening type resin to a surface of a composition containing the unhardened

radical-hardening type resin to give the composition a given shape.

(6) A production process of a member for fixing a stationary element, including the step of:

(a) applying a hardening agent for a radical-hardening type resin to a surface of a composition containing the unhardened radical-hardening type resin to give the composition a given shape; and

(b) applying a hardening agent for the radical-hardening type resin to a surface of the molded article obtained in the above step (a).

(7) The process according to (5) or (6), in which when giving a shape in the step (a), the shape is given to provide a division portion capable of dividing a molded article.

(8) The process according to any one of (5) to (7), in which the composition has a viscosity of 10 Pa·s or more and 200 Pa·s or less at 20°C.

(9) The process according to any one of (5) to (8), in which the composition has a thixotropy coefficient of 1.1 or more and 5.0 or less.

(10) A member for fixing a stationary element, produced by the process according to any one of (5) to (9).

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a view showing one example of a fixing member of

the present invention.

Fig. 2A is a view showing one example of a fixing member having division portions.

Fig. 2B is a view showing another example of a fixing member having division portions.

Fig. 3 is a view showing one example of a production process of the fixing member.

Fig. 4 is a view showing another example of a production process of the fixing member.

EMBODIMENT MODE OF THE INVENTION

The member for fixing a stationary element of the present invention contains an unhardened radical-hardening type resin, and is provided with a solid first unit having a given shape. Further, the member is provided with a second unit containing a hardening agent component for the radical-hardening type resin.

In the member for fixing a stationary element of the present invention, the unhardened radical-hardening type resin is provided as the solid first unit having a given shape. For this reason, it is not necessary to provide the member with a skin-like container which has been conventionally required to contain or cover the same. It is sufficient that a hardening agent for the radical-hardening type resin be accompanied with the first unit in various forms, for example a powder, a solid having a given shape and a liquid.

Further, such a form of the member for fixing a stationary element provides a novel and distinctive production process for the fixing member.

That is, the member for fixing a stationary element provided with an unhardened radical-hardening type resin and a hardening agent for the resin can be constructed by: preparing the unhardened radical-hardening type resin as a solid first unit having a given shape in advance (also referred to as core portion); and applying the hardening agent in various forms to the first unit. The step of filling an unhardened radical-hardening type resin into a container, which has conventionally been conventionally an essential step, can be completely eliminated. Further, according to this production process, a fixing member in various forms can be provided by giving a desired shape to the first unit.

The embodiment of the present invention is described in detail below.

(First Unit)

The first unit contains a composition containing an unhardened radical-hardening type resin (hereinafter simply referred to as "unhardened resin composition"). That is, the first unit contains the unhardened radical-hardening type resin in an amount effective for exhibiting fixing properties by virtue of a hardening reaction when using the fixing member, for example, an amount effective in fixing an anchor or the like to a fixing hole. The radical-hardening

type resin is not particularly limited, but includes epoxy acrylate resins, polyester acrylate resins, acrylic urethane resins, and unsaturated polyester resins. In particular, of the radical hardening type resins, epoxy acrylate resins and/or unsaturated polyester resins are preferable. The above-mentioned radical hardening type resins can be used alone or as a mixture of two or more kinds thereof.

In addition to each of the above radical-hardening type resins, a reactive monomer can be mixed with the unhardened resin composition. Examples of the reactive monomer include a styrene monomer, methyl (meth)acrylate, ethyl (meth)acrylate, ethylene glycol dimethacrylate, cyclohexyl phthalate, n-butyl methacrylate, 2-hydroxyethyl (meth)acrylate, benzyl (meth)acrylate, phenoxyethyl (meth)acrylate, 1,4-butyleneglycol di(meth)acrylate, trimethylolpropane trimethacrylate, dimethyl maleate, isobonyl (meth)acrylate, butanediol (meth)acrylate, 2-hydroxyethyl (meth)acrylate, and 2,2-bis[4-(methacryloxy-diethoxy)]phenylpropane.

Those radical-hardening type resins, or components obtained by adding the reactive monomers to those resins (hereinafter referred to as "main agent") are used in an amount of preferably less than 100% by weight, and more preferably 20% by weight or more and 60% by weight or less, in the composition.

The composition can contain a hardening accelerator of the

radical-hardening type resin. Examples of the hardening accelerator include: aromatic anilines such as N,N-dimethylaniline, N,N-diethylaniline, N,N-dimethyl-p-toluidine, N,N-dihydroxypropyl-p-toluidine, and N,N-dihydroxyethyl-p-toluidine; metallic soaps such as cobalt naphthenate; and chelate compounds such as vanadyl acetylacetonate. Those hardening accelerators are preferably added in the range of, for example, 0.1% by weight or more and 5% by weight or less to the radical-hardening type resin.

The composition may also contain additives preferable for solidifying the composition and for forming and maintaining the composition into and as a solid product. Specific examples of the additives that can be used include: inorganic compounds such as silicic acid, calcium carbonate, gypsum, glass flakes, mica, volcanic ash, shirasu, shirasu microballoons, concrete powder, glass microballoons, hollow glasses, and fly ash; and polysaccharides such as carboxymethyl cellulose, methyl cellulose, guar gum, locust bean gum, gelatin, PVA, gum arabic, microcrystalline cellulose, amylose, and amylopectin. The additives further include thixotropic agents such as colloidal silica, fumed silica, silica aerogel, organic modified clay, clay, silica powder, cellulose acetate, sepiolite, Aerosil (trade name, a product of Nippon Aerosil Co., Ltd.), and Thixogel (trade name, a product of Yokohama Chemicals Co., Ltd.). In the present invention, those additives can be used

alone or as a mixture of two or more kinds thereof. Of those, silicon dioxide, calcium carbonate, and calcium silicate are preferably used, and silicon dioxide is particularly preferably used.

Those additives are used in the range of preferably 300% by weight or less, and more preferably 5-50% by weight, to the radical-hardening type resin.

The unhardened resin composition can further contain aggregate. The aggregates used are not particularly limited. Artificial aggregates such as magnesia clinker, glasses and ceramics, and natural inorganic aggregates such as silica rock, marble, granite, silica sand, and quartz, can be used. Further, organic aggregates made of hard plastics such as hard vinyl chloride may be used. Preferably, the aggregates in the unit are selected that have the form and/or size to be wholly dispersed in the obtained solid unit.

If necessary, the unhardened resin composition can also contain coloring agents. By coloration, product identification ability or the like can easily be imparted to a composite in the situation where the first unit is exposed outwardly and is visually observable.

The unhardened resin composition preferably has a viscosity (at 20°C) of 10 Pa·s or more and 200 Pa·s or less. If the viscosity is less than 10 Pa·s, when the composition is discharged with a general discharging machine, the dimensional stability of a discharged product is too low to maintain the shape. In particular, even in the case of giving a given shape to a hardening agent

composition after discharging, the dimensional stability of the discharged composition is so low that the shape becomes unstable. As a result, it is difficult to obtain a desired shape. Further, if the viscosity exceeds 200 Pa·s, the proportion of a hardening agent to the amount of the radical-hardening type resin in the fixing member is excessive (in particular, this tendency is significant in the form of the fixing member in which a core portion has a hardening agent phase in a form of a coating film on a surface layer side thereof). As a result, an unreacted hardening agent is present in the resin hardened product. The unreacted hardening agent may cause the physical properties to deteriorate and in addition to this, the rotational resistance to the fixing member may become too large.

On the other hand, if the viscosity is within the above-mentioned range, during the stage of discharging the resin composition in a given amount and molding by giving a hardening agent, the dimensional stability of the resin composition is good and a desired shape may be obtained. Further in the case of implementation of the fixing member, the resin composition has a preferable viscosity for mixing the broken hardening agent and aggregates with the radical-hardening type resin composition, so that a good mixing ability may be obtained. The viscosity is more preferably 50 Pa·s or more or more preferably 100 Pa·s or less. The viscosity is most preferably 50 Pa·s or more and 100 Pa·s or less.

The viscosity of the unhardened resin composition can be measured by JIS K6833 (viscosity measurement) or a viscosity measurement method according to this reference, with a B-type viscometer, E-type viscometer, L-type viscometer, R-type viscometer, or H-type viscometer. The viscosity is expressed such that the apparent viscosity at 0.5 rpm is $\eta_{0.5}$. For example, the viscosity can be measured with a sample amount of 10.0 g using an L-type viscometer (Visco Basic L-type, a product of VISCOTECH CO., LTD.). The viscosity of the unhardened resin composition can be adjusted by the amounts of fillers or aggregates added to the radical-hardening type resin main agent. High viscosity may be obtained by increasing the blending proportion of those additives.

It is preferable for the unhardened resin composition to have a thixotropy coefficient of 1.1 or more and 5.0 or less. When the coefficient is within this range, a composition having excellent dimensional stability can be produced for the molding stage of the unhardened resin composition. As a result, a resin composition having a given shape may be obtained.

If the thixotropy coefficient is less than 1.1, deformation may occur with the passage of time when molding the unhardened resin composition. The molded composition deforms by the time a resin reacts with a hardening agent so as to harden (typically 20 to 30 minutes). As a result, a molded article having the desired shape cannot be obtained. On the other hand, if the thixotropy coefficient

exceeds 5.0, the proportion of hardening agent to the amount of radical-hardening type resin in the fixing member is excessive (in particular, this tendency is significant in the form of a fixing member in which a core portion has a hardening agent phase in a form of a coating film on a surface layer side thereof). Consequently, unreacted hardening agent may be present in the resin hardened product and the physical properties may deteriorate as a result. Further, rotational resistance to the fixing member becomes so large that implementation ability decreases. The thixotropy coefficient is more preferably 2.0 or more, more preferably 4.0 or less. The particularly preferably thixotropy coefficient is 2.0 or more and 4.0 or less.

Specifically the thixotropy coefficient can be measured by JISK6833 (6.3 Viscosity) or a viscosity measurement method according to this reference, with a B-type viscometer, E-type viscometer, L-type viscometer, R-type viscometer, or H-type viscometer. For example, the thixotropy can be measured with a sample amount of 10.0 g using an L-type viscometer (Visco Basic L-type, a product of VISCOTECH CO., LTD.), and can be expressed as a ratio of η_1/η_{10} , in which η_1 and η_{10} are the apparent viscosities at a respective rate of revolution of 1 rpm and 10 rpm.

The unhardened resin composition preferably has the viscosity or the thixotropy coefficient in the above-mentioned ranges and more preferably has both the viscosity and the thixotropy

coefficients in the above-mentioned ranges. Specifically, the viscosity (at 20°C) is 10 Pa·s or more and 200 Pa·s or less (more preferably 50 Pa·s or more and 100 Pa·s or less) and/or the thixotropy coefficient is 1.1 or more and 5.0 or less (more preferably 2.0 or more and 4.0 or less).

The first unit containing the unhardened radical-hardening type resin is appropriate if it is a solid unit having a given shape, and hardness. Viscosity, shape, and the like are not limited for the first unit.

Further, the first unit can be made in a form containing aggregates throughout the entire first unit.

(Second Unit)

The second unit contains a composition including a hardening agent for the unhardened radical-hardening type resin of the first unit (hereinafter this composition is simply referred to as a "hardening agent composition").

Examples of the hardening agent that may be used include: organic peroxides, e.g., hydroperoxides such as cumene peroxide, dialkyl peroxides such as dicumyl peroxide, diacyl peroxides such as benzoyl peroxide, ketone peroxides such as methyl ethyl ketone peroxide, bis-(4-t-butylcyclohexyl)peroxyketals, and peroxyesters such as t-butylperoxybenzoate; and materials obtained by diluting those organic peroxides with organic materials such as dicyclohexyl phthalate, or inorganic materials such as calcium carbonate and

calcium sulfonate. Peroxide-type hardening agents are preferable, and diacyl peroxides are particularly preferable. Benzoyl peroxide and a material obtained by diluting benzoyl peroxide with a diluent are most preferable.

In the present invention, the above various hardening agents can be used singularly or as a combination of two or more kinds thereof.

The hardening agent composition can further contain an additive (shape-forming agent) for imparting a given shape in addition to the hardening agent. Specific examples of the shape forming additive include: polysaccharides such as carboxymethyl cellulose, methyl cellulose, guar gum, locust bean gum, gelatin, PVA, gum arabic, microcrystalline cellulose, amylose, and amylopectin; and vinyl acetate. Various additives, preferably acrylic adhesives, can also be used.

In the present invention, the above additives can be used singularly or as a combination of two or more kinds thereof.

In addition to those, the hardening agent composition can include an appropriate filler. Examples of a filler include fibrous materials, powdery materials, granular materials, and chips or flaky materials. These fillers can contribute to an improvement in the moldability or strength of the second unit.

The composition can further include coloring agents, if necessary. In the case where the second unit is outwardly exposed

and the composite is formed so as to be visually observable, product identification ability or the like can be easily imparted to the composite by coloration.

The second unit is only required to be a phase containing a hardening agent (hardening agent phase), and may be in a solid or a liquid state (a state having flowability). In the case where the second unit is a solid, the second unit can for example, be a hardening agent layer having the configuration of a coating film shape constituting at least a part of the surface layer side of the first unit. Such a second unit may, for example, be a unit in which a composition of the second unit containing the hardening agent is applied or sprayed to the outer surface of an article having a given outer surface in an outer skin shape.

In the case where the second unit constitutes at least a part of the surface layer side of the first unit (typically, a hardening agent phase formed by applying a hardening agent composition to the surface of the first unit), the second unit can be made of a hardening agent composition containing 90% or more of the hardening agent. For example, the composition preferably contains 20% by weight or more and 60% by weight or less (preferably about 35% by weight) of a hardening agent (preferably a peroxide-type hardening agent such as benzoyl peroxide), 0.1% by weight or more and 3.0% by weight or less (preferably 2% by weight or less) of a molding material (preferably PVA), and 40% by weight or more and 80% by

weight or less (preferably about 63% by weight) of a filler (preferably calcium sulfonate).

(Member for Fixing Stationary Element)

The first unit and the second unit are substantially isolated from each other in a composite for fixing a stationary element in order to maintain hardening reactivity ability until the unhardened radical-hardening type resin and the hardening agent are required to be used. The contact portion between the first unit and the second unit is preferably provided with a hardened radical-hardening type resin layer. Particularly preferably, the radical-hardening type resin layer in the first unit is a hardened resin layer.

The hardened resin layer is provided on the surfaces at which the first unit and the second unit contact one another, preferably on the entire surface of the first unit. Such a resin layer can be formed by applying the hardening agent to the surface of the first unit and hardening the surface side of the first unit after the initial formation of the first unit.

The first unit and the second unit are preferably combined such that the unhardened radical-hardening type resin in the first unit directly contacts with the hardening agent in the second unit and the radical-hardening type resin is well hardened. To achieve this for example, the second unit can be provided in a coating film shape constituting at least a part, preferably a major part, and more preferably substantially the entire part, of the surface side

of the first unit.

Fig. 1 illustrates the embodiment of the member for fixing a stationary element.

In a fixing member 1 in the first embodiment shown in Fig. 1, the first unit 2 has a rod shape, and the second unit 4 has an outer skin shape covering at least a portion or the entire outer surface of the rod shape material. Therefore a rod shape appears as the whole fixing member. In the fixing member of such an embodiment, it can be established that the first unit constitutes a core portion. Further, it can be established that the second unit includes the hardening agent phase constituting at least a part of the surface layer side of the first unit.

According to such an embodiment the preferable quantitative ratio between the unhardened radical-hardening type resin and the hardening agent is readily obtained. Further, it is relatively easy to secure uniform mixing in breakage of the fixing member. By substantially configuring the size of the rod shaped material to coincide with the size of generally used fixing members, the rod shaped material can be used as a fixing member as is. For example, the cross-sectional area can be about 0.1 to 28 cm² and the length can be 5 to 500 mm (generally 50 to 60 mm).

The above first embodiment is further explained below.

In the member for fixing a stationary element including a combination of the core portion and the hardening agent phase

configured as above, it is sufficient that the core portion be a solid unit having a given shape and hardness. Viscosity, shape, and the like are not limited. Preferably, the core portion is provided with a shape retention ability or a strength capable of maintaining the shape of the core portion itself. Examples of specific shapes include a rod shape and spherical shape, and indefinite shape.

The hardening agent phase is not particularly limited in its present form. The phase is preferably an outer skin covering the surface of the core portion and is more preferably an outer skin covering almost the entire outer surface of the core portion.

In the association with aggregates, the core portion can be formed so as to incorporate the aggregates in the center of the core portion in addition to an embodiment containing the aggregates throughout the entire core portion.

In the fixing member of the present invention, the hardening agent is preferably in an amount of 1 to 70% by weight based on the weight of the entire first unit. If the amount is less than 1% by weight, the amount of the hardening agent is so small that a sufficient hardened state of the radical-hardening type resin may not be obtained. If the amount exceeds 70% by weight, a problem is liable to result in the moldability or strength of the hardened resin. More preferably, the hardening agent amount is 10 to 30% by weight, and this range is particularly preferable with a

peroxide-type hardening agent such as benzoyl peroxide. Further, the hardening agent amount is preferably 1 to 10% by weight based upon the weight of the unhardened radical-hardening type resin (including reactive monomers).

A fixing member 91 shown in Fig. 2(A) and Fig. 2(B) is of a form in which a plurality of fixing members 91a (corresponding to one perforation) are separably united in one body. The connection form is not particularly limited, and it is possible to employ the form in which the fixing members 91a are provided with a division part 96 and can be easily separated when in use. The fixing member 91 shown in Fig. 2(A) has rod shape fixing members 91a arranged together horizontally, and has respective division parts 96 between the fixing members 91a. The fixing member 91 shown in Fig. 2(B) is of a form in which rod shaped fixing members 91a have division parts 96 along a lengthwise direction, and separable or respective fixing members 91a are connected in tandem. Such a fixing member 91 is of a preferable distribution and supply form for fixing members used in large numbers.

In the fixing member of such a form, the portion in the vicinity of the interface, at which the core portion and the hardening agent phase contact with each other, contains the hardened radical-hardening type resin. The hardened radical-hardening type resin is a product resulting from the reaction between the unhardened radical-hardening type resin in the core portion and the hardening

agent in the hardening agent phase. A phase (bonding phase) containing such a hardened radical-hardening type resin is formed by: bringing the hardening agent to the surface layer of the core portion; making the hardening agent present along the surface layer side of the core portion; placing the unhardened radical-hardening type resin in the core portion in contact with the hardening agent; and reacting the unhardened radical-hardening type resin with the hardening agent at such a contact site. Therefore, the present form of the phase is not particularly specified.

The isolation state in the fixing member of this form is secured by the hardened radical-hardening type resin formed in the vicinity of the interface between the core portion and the hardening agent phase.

As shown in Figs. 2, in the member 91 for fixing a stationary element of this form, provided with the core portion and the hardening agent phase, a part of the member can be provided with a division portion 96 capable of forming at least two divided bodies (fixing members 91a), each having a core portion and a hardening agent phase. Such a division portion 96 may be a brittle portion that tends to receive a more stress than the circumference. For example, the division portion can be a brittle portion which can easily be broken by hand, or which can be separated or fractured, for example, by applying an impact to the exterior with an appropriate device. Such a division portion 96 can take various forms. For example, the

sectional area of the fixing member may be formed smaller than that of the circumference in the boundary part to be divided. Alternatively, a depressed portion in the shape of a line may be formed. Further, a depressed portion or the like is formed for accommodating the device for applying an impact. If necessary, any form suitable for use as a division can be employed. In the case where the division portion 96 is of a depressed shape, it is preferable that the deepest part of the depressed portion reach the core portion. The division portion is broken and divided prior to the use of the fixing member. In addition to this, the division portion allows the easy disintegration of the fixing member by an anchor such as a bolt when inserting a fixing member provided with a division portion into a fixing hole. That is, in this configuration, the division portion can improve the disintegration ability of the fixing member or the mixing ability of the resin and the hardening agent. It is preferable that the division portion be formed at a site and in a shape intended to improve the disintegration ability and mixing property. For this reason, the division portion is preferably constituted of a plurality of brittle portions. It is more preferable that the brittle portions be provided so as to be capable of dividing the fixing member into a plurality of portions along a lengthwise direction.

In particular, in a fixing member of this form, it is preferable that the hardening agent amount be 1% by weight or more and 70%

by weight or less to the weight of the core portion. If the amount is less than 1% by weight, the amount of hardening agent is so small that a sufficiently hardened state of the radical-hardening type resin is not obtained. If the amount exceeds 70% by weight, the fixing member is liable to experience problems with the moldability or strength of the hardened resin. More preferably, the amount is 1% by weight or more and 20% by weight or less to the weight of the core portion. This range is particularly preferable in a peroxide-type hardening agent such as benzoyl peroxide. Further, it is preferable that the weight of the hardening agent be 1% by weight or more and 30% by weight or less to the weight of the unhardened radical-hardening type resin (including reactive monomers).

(Composite-Forming Method)

Composite formation is now explained as the case where the first unit and the second unit are each solid. In this case, a composite can be formed after giving a given shape, or a composite can be formed by applying a composition of one unit of solid materials to the other unit.

For example, in the case of the composite form as shown in Fig. 1 in which the first unit is present inside of the fixing member, the first unit is obtained in advance, and then the other unit is applied. Specifically, the composite can be obtained by: molding the inside unit through extrusion molding or other molding methods; in some cases, cutting and/or remolding the resulting molding to

a desired form in some cases; and subsequently applying a composition so as to constitute an outer skin side unit. The outer skin side unit composition only has to be in a form which is easily applied to the outer surface of the inside unit. For example, if coating or spraying is employed, a composition having an appropriate level of flowability is used. If immersion is employed, a composition having a medium suitable for being added is used. It is particularly preferable for the composition for the outer skin side unit to have some degree of adhesion, and such a composition can include various adhesives, preferably acrylic adhesives.

The composition of the outer skin side unit applied to the inside unit is generally dried; if necessary, heated or the like; and then integrally bonded.

Next, an explanation is given for other methods of producing a fixing member of a form particularly provided with a first unit as the core portion, and a second unit as a hardening agent phase constituting at least a part of the surface layer side of the core portion. Fig. 3 and Fig. 4 illustrate two kinds of methods used as other production methods.

In these methods, it is preferable that the hardening agent of the radical-hardening type resin be supplied to the surface of a composition containing an unhardened radical-hardening type resin, and thereafter a given shape be provided to the composition. According to such a shape-giving step, that is, the step of supplying

the hardening agent composition to the surface of the unhardened radical-hardening type resin composition (molding precursor) prior to molding and then molding the composition, a composite form composed of the core portion and the hardening agent phase can be obtained at once without additional processing. Further, an arbitrary shape can be given to the fixing member.

To obtain the core portion, it is preferable to use an unhardened resin composition blended for molding as described above. An unhardened composition containing a molding agent is particularly preferably used. The composition may contain a medium such as water for giving an appropriate level of flowability or the like, prior to molding.

Various components of the composition are mixed and kneaded to prepare an unhardened resin composition. Prior to giving a shape to this unhardened resin composition, it is preferable to divide the composition into an appropriate size. That is, it is preferable to divide the composition into quantities according to the final form of the fixing member or the final packaging form of the fixing member (for example, a form in which a plurality of fixing members are separably connected). The division means is not particularly limited, and any means can be employed if the composition having an appropriately increased viscosity can be divided.

The form of the composition after division is not particularly limited. The divided composition may have an indefinite shape or

may have a particular shape to a certain extent. The divided composition preferably does not have the final shape. Further, the surface may be adhesive or flowable. To maintain hardening reactivity, strength, or the like of the fixing member when in use, it is preferable for the unhardened resin composition to have as low as possible content of a shape-retaining agent or the like. Therefore, the unhardened resin composition introduced in the supply step of the hardening agent composition preferably has viscoelasticity or level of flowability which allows plastic deformation due to a small external force. In other words, it is preferable that such a composition have viscoelasticity or level of flowability to an extent such that the composition does not cause plastic deformation and can retain its shape even if an external force of more than the predetermined force is applied by the completion of the surface hardening by supplying the hardening agent composition to the composition. Viscoelasticity or flowability of the unhardened resin composition varies depending on the shape or the molding means used.

For example, division of the unhardened resin composition into a specific quantity can be conducted by extruding or discharging the composition to form a continuous body having a specific cross sectional shape, and then cutting the same into a given length.

Next, the surface of the unhardened resin composition, prior to final molding (molding precursor), is supplied with a composition

containing the hardening agent for the unhardened radical-hardening type resin. The composition is preferably supplied to the entire surface of the unhardened resin composition. The supply method is not particularly limited. Spraying, spreading, dipping, or the like can appropriately be selected and employed.

Thus, by supplying the hardening agent composition to the surface of the unhardened resin composition, a hardening reaction of the unhardened radical-hardening resin and the hardening agent occurs on the surface of the unhardened resin composition to form a radical-hardening type resin. The hardening agent-containing composition is integrally well bonded to the surface of the unhardened resin composition by this hardened radical-hardening type resin. At the same time, this hardened layer can maintain the hardening reactivity of the unhardened radical-hardening type resin present inside of the fixing member.

Further, by supplying the hardening agent composition to the unhardened resin composition before molding, even if the resin composition is an unhardened resin composition provided with some amount of viscoelasticity or flowability, a specific shape can be maintained. Therefore, according to this method, after supplying the hardening agent composition to the unhardened resin composition, a desired shape is given using various shape-giving means. At the same time, the unhardened resin composition and the hardening agent composition are integrally bonded together. This enables a molded

article (fixing member) to be obtained at one time.

It is not necessary that the production of the fixing member be completed simultaneously with molding thereof by supplying the hardening agent composition. The final fixing member can be obtained such that materials corresponding to the sizes of a plurality of fixing members are molded at one time, and then are divided by appropriate means. In this situation, it is preferable to supply the hardening agent composition again to a newly exposed site of the unhardened resin composition exposed by the division.

Further, after molding, it is preferable to conduct a drying step by leaving the composition to stand for a period of time, actively blowing air, and/or heating. Such a drying step can also serve as a hardening step in which a hardening reaction simultaneously proceeds and ultimately completes. By practicing such drying and/or heating, the shape can be stabilized.

Further, a hard hardening agent phase can be given by supplying the hardening agent composition to the obtained molded article. The hardening agent supplied in this case preferably contains a large amount of the molding agent relative to that of the hardening agent already supplied. Further, the form of the hardening agent supplied in this case is not particularly limited. However, because the core portion is already molded, a liquid hardening agent composition can be used. Use of the liquid hardening agent composition facilitates use of an efficient supply method such as

dipping, immersion, or liquid spraying.

Various methods can be employed as the specific molding method. A shape-giving means, suitable for use after supplying the hardening agent composition, is rolling compaction, press molding, or the like. Although molding can be carried out immediately after supplying the hardening agent composition or while supplying the hardening agent composition, after supplying the hardening agent composition the resultant can be left to stand for a certain time period to allow hardening to proceed to a certain extent, and then the resultant can be supplied to a shape-giving step.

For example, the step shown in Fig. 3 is a state of supplying the hardening resin composition to the surface of the unhardened resin composition. A precursor 102, before molding, is conveyed while being rotated with a conveyer, and is passed through a press site 104 formed with a clearance having a given size, thereby molding into a pillar-shaped body 106 having a given diameter. Thus, a fixing member is obtained provided with a core portion and a hardening agent layer. The molding method is not limited to such a rolling compaction process, but general press molding can also be employed.

In a step shown in Fig. 4, an unhardened resin composition 202 is arranged between rotating two molding rollers 204 which are arranged such that the respective peripheral surfaces face each other, and the composition is held between the rotating rollers 204 at the site while being rotated, thereby molding the composition

202. During molding, by supplying a hardening agent composition 206 to the surface of this composition 202, the surface of the composition 202, held between the rotating rollers 204, is solidified. As a result, a pillar-shaped first unit or fixing member can be molded. The molding rollers 204 each preferably have a nearly circular or circular cross section. If the rollers each have a nearly circular or circular cross section, columnar material can easily be obtained.

In this method, the composition 202 is gradually extended along the axial direction of the rotating rollers 204. Therefore, according to this method, the first unit or fixing member may be obtained having a consistent size (in many cases, corresponding to a length). At the same time, the cross-section is also consistent. As a result, the first unit or fixing member may be obtained having a uniform shape as a whole.

The supply period or supply site of the hardening agent composition 206 is not particularly limited, but it is preferable that the hardening agent composition 206 be supplied to a mainly peripheral surface along the axial direction of rollers 204 of the composition 202 in an initial stage of the molding step. In other words, it is preferable that the hardening agent composition 206 is not supplied to both extending extremities. Thereafter, when the composition 202 has a nearly desired length, or when the composition 202 is extended to a certain extent which is shorter

than the desired length, the hardening agent composition 206 is supplied to the extending extremities (edge faces) of the composition 202 that is extended or is extending, along an axial direction, thereby solidifying the extending extremities. As a result, both the extremity position and shape can be controlled. In this method, shielding members 208 are arranged at both ends along the extending direction of the composition. That is, the members 208 are positioned at sites corresponding to the bottom and top of a columnar body having a desired size so that the extending composition contacts with the members 208 and does not extend any further. The shielding member 208 may determine the size (in many cases, length) of a shape of the composition to be molded, and can also give a shape to the extremities of the composition 202 as a result of the shape of the contact faces. In particular, after applying the hardening agent 206 to the extended extremities, the length and extremity shape of the composition 202 can be effectively manipulated by contacting the extremities with the shielding members 208. The shielding members 208 may appropriately be used to control the extension of the extremities of the composition 202 being molded, not only at the final stage of a molding step, but also from the initial stage or in a part of the molding step.

According to the method of supplying the hardening agent composition to the molding precursor as mentioned above, because the shape is formed in a state after the application of the hardening

agent composition, moldability is improved. For this reason, various shapes can easily be formed. In addition, various shapes can easily be formed for not only the entire fixing member, but also for the surface side thereof. For example, a brittle portion, such as a depressed portion, which can divide the fixing member, can be easily formed. Additionally, a form can be employed of separably connecting a plurality of fixing members. The connection form is not particularly limited. For example, as shown in Fig. 2(A), the fixing member can be in a form in which pillar-shaped bodies having the same size are arranged to also have the same length. In this case, the division portion 96, capable of separating into each pillar-shaped body, is formed between the adjacent pillar-forming sites. Further, as shown in Fig. 2(B), the fixing member can be in a form which can be divided along the lengthwise direction.

When giving a shape, if necessary the temperature of the unhardened resin composition and/or the hardening agent composition may be controlled. In the case of rapidly speeding the hardening reaction, it is preferable to heat to a temperature to such an extent that the hardening reaction of the connection can be accelerated. In the case of retarding the speed of the hardening reaction, the composition is cooled to a temperature to such an extent that the hardening reaction can be inhibited.

The molded article having a shape thus formed can be used as

is as a fixing member of the present invention, or the hardening agent composition can be further supplied to the surface thereof to be used as the fixing member of the present invention. Further, by again applying unhardened resin composition to the surface of the molded article, and then applying another coating of the hardening agent composition, a laminate structure may be formed of the unhardened resin composition phase and the hardening agent phase.

In each of the above composite formation methods, the first unit and the second unit contact with each other. By contacting, a hardening reaction of the radical-hardening type resin contained in the first unit occurs at a contact site (including bonding site) of the first unit and the second unit. As a result, a hardened radical-hardening type resin layer is formed at the contact site.

The hardening resin layer may be separately formed on the outer surface of the first unit prior to the composite formation step. Alternatively, the hardening resin layer can be formed by supplying the unhardened resin composition to the surface of the second unit.

As explained above, the present invention provides: the first unit, the unhardened resin composition for the first unit, the second unit, and the hardening agent composition for the second unit, which form the structural elements of the fixing member in addition to being members for fixing a stationary element; and the process for producing the fixing member.

The fixing member of the present invention is provided with

a solid first unit containing the unhardened radical-hardening type resin. As a result, the conventionally indispensable container for the radical-hardening type resin and a filling operation for the container can be eliminated. By this invention, structural elements substantially unnecessary to the fixing of the stationary element can be eliminated from the fixing member.

Further, in the situation where an unhardened resin, having a large volume ratio to the fixing member, is used as the first unit in the form of a molded article, the overall form or size of the fixing member is provided from the first unit. As a result, various forms or sizes can be easily provided.

Further, in the situation where the second unit is also solid, a composite form with the first unit may be easily employed. In particular, by forming the second unit into a coating film shape constituting at least a part of the surface layer side of the first unit, a fixing member can be provided that is easily produced and has excellent mixing and hardening abilities.

The fixing member of the present invention is suitable for fixing a stationary element for reinforcement, such as an anchor. The fixing member of an anchor rib is provided which is excellent economically and in use.

(Examples)

The present invention is described with respect to one specific example, but the present invention is not construed as being limited

to neither the specific example nor the following Examples.

(Example 1)

4 g of a molding agent and 60 g of calcined aggregates were mixed with 25 g of an unsaturated polyester resin as a radical-hardening type resin. The kneaded unhardened resin composition (JIS K6833, L-type viscometer, sample weight: 89 g, 20°C, viscosity: 80 Pa·s (rate of revolution: 0.5 rpm), thixotropy coefficient $\eta_1/\eta_2=3.0$) was discharged in a given extrusion amount and cut into a lengths of 90 mm. 5 g of a peroxide-type powdery hardening agent was applied to the outer surface, and this composition was lightly pressed while being rotationally moved on a conveyer. Simultaneously, a columnar shape having depressions was given that enabled the composition to be divided at a middle portion in the lengthwise direction, followed by leaving the composition to stand for 2 hours or longer at ordinary temperature. Thus, a molded article was obtained. Thereafter, 10 g of a peroxide-type hardening agent and 20 g of fillers were mixed to prepare a hardening agent composition. Separately, 1 g of POVAL in solid powder was dissolved in 30 g of water under heating, followed by gradually cooling at ordinary temperature, thereby obtaining a mixed slurry. This slurry was applied to the surface of the molded article, and dried for 24 hours to obtain a fixing member. Finally, a fixing member was obtained having an outer diameter of 10 mm and a length of 100 mm, and having a dividable depression at a middle position of 50 mm.

(Example 2)

The fixing member of Example 1 was subjected to the following strength test.

A perforation having a diameter of 14 mm and a depth of 120 mm was formed in a concrete block having a compressive strength of 21 N/mm².

The fixing member having an outer diameter of 10 mm and a length of 100 mm produced in Example 1 was inserted to the perforation. An M12 screw bolt having a tip obliquely cut at 45° was mounted on an electric drill and was embedded to a certain length while being rotated. After casting and hardening for 24 hours, the maximum drawing strength was measured with a hydraulic measurement device. Three fixing members each had a maximum drawing strength of 60 kN or higher, which indicated a good result.

(Example 3)

The following strength test was conducted on the fixing member having an outer diameter of 10 mm and a length of 100 mm produced in Example 1, which was divided at the depressed portion in the middle.

A perforation having a diameter of 14 mm and a depth of 60 mm was formed in a concrete block having a compressive strength of 21 N/mm².

The fixing member having an outer diameter of 10 mm and a length of 50 mm produced in Example 1 and divided at the middle division

was inserted into the perforation. An M12 screw bolt having a tip obliquely cut at 45° was mounted on an electric drill and was embedded to a certain length while being rotated. After casting and hardening for 24 hours, the maximum drawing strength was measured with a hydraulic measurement device. Three fixing members each had a maximum drawing strength of 30 kN or higher, which indicated a good result.

From those results, it is understood that the fixing members as produced in Example 1 each have good level of fixing strength and provide a good rigidity of anchor, and also exhibit consistent strength.

(Example 4)

5 g of silicon dioxide (trade name: NIPSIL, a product of Nippon Silica Industrial Co., Ltd.) and 5 g of calcined aggregates were mixed with 30 g of an unsaturated polyester resin as a radical-hardening type resin. The kneaded unhardened resin composition (JIS K6833, L-type viscometer, sample weight: 40.0 g, 20°C , viscosity: 9 Pa·s (rate of revolution: 0.5 rpm), thixotropy coefficient $\eta_1/\eta_2=1.0$) was discharged in a given extrusion amount and cut into lengths of 60 mm. 5 g of a peroxide-type powdery hardening agent was applied to the outer surface and this composition was lightly pressed while being rotated. As a result, deformation occurred before the formation of an outer surface coating film. After hardening for approximately 2 hours, the cross-section altered

into a flattened elliptical shape. Thus, a molded article having a desired columnar shape could not be obtained.

(Example 5)

100 g of silicon dioxide (trade name: NIPSIL, a product of Nippon Silica Industrial Co., Ltd.) and 120 g of calcined aggregates were mixed with 30 g of an unsaturated polyester resin as a radical-hardening type resin. The kneaded unhardened resin composition (JIS K6833, L-type viscometer, sample weight: 50.0 g, 20°C, viscosity: 220 Pa·s (rate of revolution: 0.5 rpm), thixotropy coefficient $\eta_1/\eta_2=5.5$) was discharged in a given extrusion amount and cut into lengths of 60 mm. 5 g of a peroxide-type powdery hardening agent was applied to the outer surface and this composition was lightly pressed while being rotated, thereby obtaining a molded article having a diameter of 9 mm and a length of 60 mm.

The following test were conducted using this molded article.

Fixing test were conducted on three molded articles using an anchor bolt D10 and a perforation (diameter: 11.5 mm and length: 60 mm). As a result, in one test sample the anchor could not be embedded to the bottom of the hole. In the remaining two test samples the anchors could be embedded but the drawing strengths of the anchors were 0.2 kN and 0.1 kN, respectively. The results confirmed that the resin composition apparently showed poor hardening due to an excessive amount of hardening agent. Further, the anchor drawing strength was very low as compared with a conventional value of 20

kN to 30 kN. As a result, the anchor could not be used.

INDUSTRIAL APPLICABILITY

According to the composite of the present invention, fixing members are provided from which structural elements unnecessary for fixing a stationary element have been eliminated. Further, according to the production process of the present invention, production steps are simplified for the member for fixing a stationary element.

CLAIMS

- (1) A member for fixing a stationary element, comprising:
a core portion containing an unhardened radical-hardening type resin; and
a hardening agent phase constituting at least a part of a surface layer side of the core portion, and containing a hardening agent for the radical-hardening type resin,
wherein an inner phase containing the unhardened radical-hardening type resin of the core portion has a viscosity of 10 Pa·s or more and 200 Pa·s or less at 20°C.
- (2) A member for fixing a stationary element, comprising:
a core portion containing an unhardened radical-hardening type resin; and
a hardening agent phase constituting at least a part of a surface layer side of the core portion, and containing a hardening agent for the radical-hardening type resin,
wherein an inner phase containing the unhardened radical-hardening type resin of the core portion has a thixotropy coefficient of 1.1 or more and 5.0 or less.
- (3) A member for fixing a stationary element according to claim 2, wherein at least one of the core portion and the hardening agent phase contains aggregates.
- (4) A member for fixing a stationary element, comprising:
a core portion containing an unhardened radical-hardening type

resin;

a hardening agent phase constituting at least a part of a surface layer side of the core portion, and containing a hardening agent for the radical-hardening type resin; and

a division portion provided so as to be capable of forming at least two divided bodies each having the core portion and the hardening agent phase.

(5) A production process of a member for fixing a stationary element, comprising the step of:

(a) supplying a surface covering of a composition containing an unhardened radical-hardening type resin with a hardening agent for the radical-hardening type resin, to allow the composition to form a desired shape.

(6) A production process of a member for fixing a stationary element, comprising the steps of:

(a) supplying a surface of a composition containing an unhardened radical-hardening type resin with a hardening agent for the radical-hardening type resin, to give the composition a given shape; and

(b) supplying a surface covering of a molded article obtained in the above step (a) with a hardening agent for the radical-hardening type resin.

(7) A process according to claim 5 or 6, wherein when giving a shape in the step (a), the shape is given so as to provide a division

portion capable of dividing a molded article to be obtained.

(8) A process according to any one of claims 5 to 7, wherein the composition has a viscosity of 10 Pa·s or more and 200 Pa·s or less at 20°C.

(9) A process according to any one of claims 5 to 8, wherein the composition has a thixotropy coefficient of 1.1 or more and 5.0 or less.

(10) A member for fixing a stationary element, produced by the process according to any one of claims 5 to 9.