

TITLE OF THE INVENTION

Molding composition, molded parts, and method of manufacturing molded parts

TECHNICAL FIELD OF THE INVENTION

The present invention relates to molding composition, molded parts, and method of manufacturing molded parts.

BACKGROUND OF THE INVENTION

Hitherto, the method of manufacturing molded parts buried in thermosetting resin comprises the steps of:

- (1) putting parts to be buried into a heated die,
- (2) filling the die containing the parts with a thermosetting resin before curing which is a molding material by injection method or transfer method to cover the parts with the resin,

- (3) curing the thermosetting resin in the die by heating over the reaction starting temperature, and

- (4) finally curing completely to finish the curing reaction, and taking out the molded parts from the die.

In order to shorten the curing time and enhance the productivity, it is necessary to raise the temperature of the molding material over the reaction starting

temperature as promptly as possible. For this purpose, by preliminarily heating the parts to be buried or the molding material, it is attempted to shorten the curing time.

In the conventional method of preliminarily heating the parts to be buried, when the parts are heated to a temperature close to the reaction starting temperature of the thermosetting resin, curing starts in the process of injecting the mold into the die in which the heated parts are placed, and the molding material is not completely injected into the die, or the molding material is not completely charged into the parts. Or, the cured molded parts are cracked, and complete molded parts are not obtained. Thus, the preliminary heating temperature of the parts to be buried cannot be raised too high.

Besides, the reaction starting temperature and curing time of the thermosetting resin depend greatly on the type of the polymerization initiating agent such as peroxide added to the resin, and hence the curing time was controlled by selecting the type of the polymerization initiating agent. However, the polymerization initiating agent for shortening the curing time generally drops the reaction starting temperature at the same time, and the storage period of the molding material is shorter,

and the storage stability of the molding material is inferior.

It is hence an object of the invention to present a molding composition enhanced in productivity and a method of manufacturing molded parts.

SUMMARY OF THE INVENTION

A molding composition of the invention comprises:

an unsaturated alkyd resin, and

a crosslinking monomer to be crosslinked to the unsaturated alkyd resin,

in which the crosslinking monomer includes a first

crosslinking monomer having $\begin{array}{c} | \\ [C=C] \\ | \end{array}$ group, $[-CO_2-]$ group,

and $[-OH]$ group.

A molded part of the invention comprises:

(a) a cured resin in a molding composition comprising

(1) an unsaturated alkyd resin, and

(2) a crosslinking monomer to be crosslinked to the unsaturated alkyd resin,

in which the crosslinking monomer includes

a first crosslinking monomer having $\begin{array}{c} | \\ [C=C] \\ | \end{array}$ group,

$[-CO_2-]$ group, and $[-OH]$ group, and

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(b) an electronic component installed as being covered with the cured resin.

A method of manufacturing a molded part of the invention comprises:

(a) a step of covering the surrounding of an electronic component that can be heated with a molding composition,

(b) a step of feeding power to the electronic component for generating heat in the electronic component, and

(c) a step of curing the molding composition by the heat generated in the electronic component.

Preferably, the first crosslinking monomer is at least one of 2-hydroxyethyl acrylate and 2-hydroxyethyl methacrylate.

Preferably, the electronic component has a coil formed by winding a conductive wire, and the coil generates the heat by feeding power to the coil.

In this constitution, the curing time of the molding composition is shortened. Moreover, the productivity of the molded parts is enhanced.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic perspective view of a stator of a motor used in a method of manufacturing molded parts

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in an embodiment of the invention.

Fig. 2 is a schematic perspective view of a stator of a motor used in a method of manufacturing molded parts in other embodiment of the invention.

REFERENCE NUMERALS

- | | |
|---|-------------------------------|
| 1 | Iron core |
| 2 | Coil |
| 3 | Insulator |
| 4 | Iron core |
| 5 | Coil |
| 6 | Temperature measuring section |

DETAILED DESCRIPTION OF THE INVENTION

A molding composition of the invention comprises:

an unsaturated alkyd resin, and

a crosslinking monomer to may be crosslinked to the unsaturated alkyd resin,

in which the crosslinking monomer includes a first

crosslinking monomer having $[C=C]$ group, $[-CO_2-]$ group,

and $[-OH]$ group.

A molded part of the invention comprises:

(a) a cured resin in a molding composition comprising

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(1) an unsaturated alkyd resin, and

(2) a crosslinking monomer to may be crosslinked to the unsaturated alkyd resin,

in which the crosslinking monomer includes

a first crosslinking monomer having $\begin{array}{c} | \quad | \\ \text{[C=C]} \\ | \quad | \end{array}$ group,

$[-\text{CO}_2-]$ group, and $[-\text{OH}]$ group, and

(b) an electronic component installed as being covered with the cured resin.

A method of manufacturing a molded part of the invention comprises:

(a) a step of covering the surrounding of an electronic component that can be heated with a molding composition,

(b) a step of feeding power to the electronic component for generating heat in the electronic component, and

(c) a step of curing the molding composition by the heat generated in the electronic component.

Preferably, the electronic component has a coil formed by winding a conductive wire, and the coil generates the heat by feeding power to the coil.

Preferably, the first crosslinking monomer having

$\begin{array}{c} | \quad | \\ \text{[C=C]} \\ | \quad | \end{array}$ group, $[-\text{CO}_2-]$ group, and $[-\text{OH}]$ group has

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[C=CCO2-] group and [-OH] group.
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Preferably, the first crosslinking monomer is at least one of 2-hydroxyethyl acrylate and 2-hydroxyethyl methacrylate.

Preferably, the crosslinking monomer further includes a second crosslinking monomer containing styrene.

Preferably, the content of the crosslinking monomer is in a range of about 1 mol.% to about 80 mol.% of the crosslinking monomer.

Preferably, the total content of the styrene and first crosslinking monomer is about 90 mol.% or more of the crosslinking monomer.

Preferably, the molding composition includes at least one selected from the group consisting of reaction initiator, filler, reinforcing material, low shrinking agent, coloring matter, thickener, and parting agent.

In the invention, the composition containing the unsaturated alkyd resin and crosslinking monomer is called an unsaturated polyester.

The unsaturated polyester in the invention is not particularly limited, but, for example, an unsaturated

polyester comprising an unsaturated alkyd generated by reaction of unsaturated polybasic acid, saturated polybasic acid and glycols, and a crosslinking monomer may be used.

An unsaturated group (that is, C=C group) in the chemical structure of unsaturated alkyd polymerizes with an unsaturated group (that is, C=C group) of the crosslinking monomer, and a crosslinked cured resin is generated. As the unsaturated polybasic acid, for example, maleic anhydride, fumaric acid, itaconic acid, or the like may be used.

Examples of saturated polybasic acid include, among others, phthalic anhydride, isophthalic acid, terephthalic acid, tetrahydrophthalic anhydride, methyl tetrahydrophthalic anhydride, endomethylene tetrahydrophthalic anhydride, tetrabromophthalic anhydride, adipinic acid, and sebacic acid.

Example of glycol include, among others, propylene glycol, ethylene glycol, diethylene glycol, dipropylene glycol, neopentyl glycol, dibromoneopentyl glycol, 1,3-butane diol, 1,4-butane diol, and hydrogenated bisphenol A.

Either 2-hydroxyethyl acrylate or 2-hydroxyethyl methacrylate is a kind of crosslinking monomer including

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[C=C] group, $[-CO_2-]$ group and $[-OH]$ group, which

crosslinks with unsaturated alkyd and has a function of shortening the curing time.

In addition to the unsaturated alkyd resin and crosslinking monomer, it is also possible to use a molding composition containing other crosslinking monomer such as methyl methacrylate, vinyl acetate, vinyl toluene, alpha-methyl styrene, and methyl acrylate. Of these monomers, styrene is preferred, and this composition is characterized by excellent crosslinking reaction and low cost.

The rate of 2-hydroxyethyl acrylate or 2-hydroxyethyl methacrylate contained in the crosslinking monomer is preferred to be in a range of about 1 mol.% to less than about 80 mol.%, and most preferably 30 to 70 mol.%. If the rate of 2-hydroxyethyl acrylate or 2-hydroxyethyl methacrylate contained in the crosslinking monomer is less than about 1 mol.%, the effect for shortening the curing time is small. If contained more than about 80 mol.%, too, the effect for shortening the curing time is small.

Or, in the composition containing at least one of 2-hydroxyethyl acrylate and 2-hydroxyethyl methacrylate, styrene and other crosslinking monomer, the total of the

hydroxyacrylate compound and styrene in the composition is particularly preferred to be 90 mol.% or more, and in this case it is inexpensive, excellent in crosslinking property, and capable of shortening the curing time at the same time.

In the case of the composition containing 10 mol.% or more of other crosslinking monomer than the hydroxyacrylate compound and styrene, the effect for shortening the curing time by the hydroxyacrylate may be smaller, or the resin may be likely to be left over in the die, and other problems may occur.

The total amount of the crosslinking monomer is preferred to be the addition of about 1.3 times to about 5 times by molar ratio to the unsaturated polybasic acid. If the molar ratio of the crosslinking monomer to the unsaturated polybasic acid is less than about 1.3, the unreacted portion of unsaturated polybasic acid increases, which results in decline of the strength of the molding or the plastic molding using its composition as the binder. If the molar ratio of the crosslinking monomer to the unsaturated polybasic acid is more than about 5, much unreacted monomer is left over, and the strength of the plastic molding is lowered.

It is also possible to mix addition additives such as filler, reinforcing material, low shrinking agent,

reaction initiator, coloring matter, thickener, and parting agent in the molding composition.

Examples of the filler include powders of, among others, calcium carbonate, calcium silicate, magnesium carbonate, barium sulfate, calcium sulfate, kaolin, aluminum hydroxide, talc, mica, diatom earth, and glass. The shape of the powder is not particularly limited.

As the reinforcing material, glass fiber, ceramic fiber, carbon fiber, organic fiber or the like is used.

Organic fibers include vinylon, polypropylene, polyester, aramid fiber, and others.

As the carbon fiber, a baked composition of polyacrylonitrile, rayon or the like is used.

Examples of the low shrinking agent include, among others, polystyrene, polycaprolactone, polydipropylene adipate, and polydipropylene isophthalate.

Examples of the reaction initiator include, among others, t-butyl peroctanate, benzoyl peroxide, t-butyl perbenzoate, 2,2, bis (t-butyl peroxy) butane, 3,3,5, trimethyl (t-butyl peroxy) cyclohexane.

As the coloring matter, general dyes or pigments may be used, for example, iron oxide, titanium oxide, cadmium yellow, cadmium red, chrome yellow, chrome vermilion, ultramarine, other inorganic pigments, azo compounds, cyanine blue, chlorinated cyanine blue,

cyanine green, other organic pigments, indigo red, oil red, other dyes, and carbon black.

Examples of the thickener include magnesium oxide, magnesium hydroxide, calcium hydroxide, polyhydric isocyanate compound, and others.

As the parting agent, for example, fluorine derivative surface active agent or zinc stearate is used.

In the method of manufacturing molded parts of the invention, the parts to be buried are electronic components which generate heat when power is supplied, such as winding coils. In order to utilize the heat generation by power feeding sufficiently, the components having many heat generating parts are preferred, and, for example, motors and transformers are particularly preferred.

As the conductive material of the coil used as the heat generating part, a material having a large specific heat is preferred, and, for example, copper and aluminum are preferred. Such materials can raise the temperature by a small energy of power feeding.

As the insulation film of coil winding, for example, polyvinyl formal, nylon, polyester, polyurethane, polyester imide, polyamide, polyimide, or polyamide imide may be used. Above all, a material having a high heat resistance is preferred because the coil temperature can

be raised sufficiently.

The power feeding condition to the coil is determined by the desired surface temperature of the parts. For power feeding, either direct current or alternating current may be used, and the direct current is particularly preferred in the case of a coil because the temperature can be raised efficiently. The current or voltage to be applied varies significantly depending on the number of turns of the coil and others, and the current is preferred to be in a range of several amperes to tens of amperes, and the voltage is from tens of volts to hundreds of volts. If extremely high current or voltage is applied, the coil insulation film may be damaged or the wire may be broken, and therefore the current or voltage to be applied must be determined in consideration of the material quality of coil and others.

The surface temperature of the parts heated by power feeding is preferred to be as high as possible for shortening the curing time, within a range free from adverse effects on the coil insulation film or the like, above the reaction starting temperature of the thermosetting resin. However, if the temperature is raised too quickly, the molded parts may be cracked or the stress may be applied to the coil, and therefore an adequate temperature must be controlled to avoid such

problems, and it is not absolutely required to be higher than the reaction starting temperature of the thermosetting resin.

The thermosetting resin used in the method of manufacturing molded parts is not particularly limited, and its examples may be include, among others, unsaturated polyester containing unsaturated alkyd resin, epoxy resin, phenol resin, urea resin, silicone resin, melamine resin, diallyl phthalate resin, polyimide, and urethane resin. In particular, a thermosetting resin containing at least one of 2-hydroxyethyl acrylate or 2-hydroxyethyl methacrylate, and unsaturated polyester is preferred, and this composition shortens the curing time. More preferably, unsaturated polyester containing at least one of 2-hydroxyethyl acrylate and 2-hydroxyethyl methacrylate by about 1 mol.% to about 80 mol.% is desired, and this composition extremely shortens the curing time.

The invention is more specifically described below by referring to preferred embodiments.

Embodiment 1

An embodiment of molding composition of the invention is described below.

Six kinds of liquid resin composition were obtained by stirring and mixing (a) 100 parts by weight

of a mixture of unsaturated alkyd resin composed of phthalic anhydride, fumaric anhydride and propylene glycol in various compositions, styrene and 2-hydroxyethyl methacrylate as crosslinking monomer, and polycaprolactone as low shrinking agent, and (b) 1 part by weight of t-butyl peroxy benzoate as reaction initiator. In the liquid resin composition, the content of polycaprolactone is 6.5 wt.%. The molar ratio of the unsaturated alkyd resin to the crosslinking monomer in the liquid resin composition is about 2.8. Six kinds of liquid resin composition were prepared only by varying the rate of 2-hydroxyethyl methacrylate to the styrene. The molar concentration of 2-hydroxyethyl methacrylate in the crosslinking monomer was 10%, 20%, 30%, 50%, 70%, and 80%, respectively.

Next, using a kneader, 68.3 parts by weight of calcium carbonate as filler, 0.7 part by weight of vinylon chopped strand, 0.9 part by weight of zinc stearate as parting agent, 0.3 part by weight of carbon powder as coloring matter, and 1.8 parts by weight of polyethylene powder as surface brightener were mixed in dry process for about 5 minutes, and a uniformly blended dry mixture was obtained. To 73 parts by weight of this dry mixture, 21.2 parts by weight of the liquid resin composition was gradually added, and kneaded, and a uniform paste mixture

was obtained.

To 94.2 parts by weight of this paste mixture, 6.8 parts by weight of glass fiber was uniformly dispersed, and added in a short time, and kneading was finished when the glass fiber was wetted and dispersed uniformly.

In this way, six kinds of molding composition were obtained.

Using a curastometer, the curing time at 150°C of each molding composition was measured. Results are shown in Table 1. In this table, H (mol.%) denotes the molar concentration of 2-hydroxyethyl methacrylate in the crosslinking monomer.

As comparative example 1, by using styrene only without containing 2-hydroxyethyl methacrylate at all, a molding composition was prepared in the same condition as in the embodiment in the other respects. In this molding composition free from 2-hydroxyethyl methacrylate, the curing time was similarly measured, and its result is shown together in Table 1. In the table, H (mol.%) of this comparative example 1 is indicated by 0.

Table 1

H (mol.%)	0	10	20	30	50	70	80
Curing time (sec)	122	102	71	31	30	35	165

The following facts are known from Table 1. The curing time is shortened by containing about 10 mol.% of 2-hydroxyethyl methacrylate. At less than about 80 mol.% of the molar concentration of 2-hydroxyethyl methacrylate, the curing time tended to be shorter as the rate of 2-hydroxyethyl methacrylate increased, but the curing time was suddenly extended at about 80 mol.%. In particular, the curing time was shorted in a range of about 30% to about 70% of the molar concentration of 2-hydroxyethyl methacrylate.

That is, using the same kind of reaction initiator by the same amount, in the molding composition of which molar concentration of 2-hydroxyethyl methacrylate contained in the crosslinking monomer is about less than 80 mol.%, the curing time is extremely shortened, so that the productivity of molded parts can be enhanced. In particular, when the molar concentration of 2-hydroxyethyl methacrylate is in a range of about 30% to about 70%, the curing time is shortened most.

In the embodiment, instead of 2-hydroxyethyl methacrylate, when 2-hydroxyethyl acrylate was used, the curing time of the molding composition was shortened almost by the same degree as in the embodiment.

Embodiment 2

An embodiment of a method of manufacturing molded parts of the invention is described.

First, a method of preparing a molding composition is explained. Unsaturated polyester was obtained from 65 parts by weight of unsaturated alkyd composed of phthalic anhydride, fumaric anhydride and propylene glycol, 35 parts by weight of styrene, and 0.01 part by weight of methoxy hydroquinone as polymerization inhibitor, by stirring and dissolving at room temperature. On the other hand, by stirring and dissolving 40 parts by weight of polydipropylene isophthalate in 60 parts by weight of styrene at room temperature, a low shrinking agent was obtained.

A liquid resin composition was obtained by stirring and mixing 71 parts by weight of the unsaturated polyester, 29 parts by weight of the low shrinking agent, and 1 part by weight of 1,1-(t-butyl peroxy) 3,3,5-trimethyl cyclohexane as polymerization initiator.

Further, 17.8 parts by weight of calcium carbonate as filler, 48.5 parts by weight of aluminum hydroxide, 1.5 parts by weight of zinc stearate as parting agent, and 0.4 part by weight of carbon powder as coloring matter were mixed in dry process for 5 minutes by using a kneader. Thus, a uniformly blended dry mixture was obtained.

To 68.2 parts by weight of this dry mixture, 22 parts by weight of the liquid resin composition was gradually added, and kneaded, and a uniform paste mixture was obtained.

To 90.2 parts by weight of this paste mixture, 9.8 parts by weight of glass fiber was uniformly dispersed and added in a short time, and the kneading was finished when the glass fiber was wetted and dispersed uniformly. Thus, a molding composition 1 was prepared.

Next is explained a manufacturing method of a molded parts, using a stator of a motor as an electronic component having a winding coil wound with a conductive wire.

A schematic perspective view of the stator is shown in Fig. 1. In Fig. 1, the stator comprises an iron core 1 of 40 mm in inner diameter, 88 mm in outer diameter, and 13 mm in laminate thickness, an insulator 3 covering a part of the iron core 1, and a coil 2 having a conductive wire wound on the iron core 1. The coil 2 includes a main winding and an auxiliary winding. The characteristics of the coil 2 are shown in Table 2.

Table 2

Winding division	Wire type	Copper wire dia.	No. of windings	Connection	No. of turns	Resistance (Ω)
Main winding	1 UEW	ϕ 0.18	4X2	Series	760	250
Auxiliary winding	1 UEW	ϕ 0.18	4X2	Series	800	330

When feeding power to the coil, terminals of the main winding and auxiliary winding were coupled, and same voltage was applied to the main winding and auxiliary winding.

A method of manufacturing a molded stator by burying such stator and molding is described. First, thermometers are attached to the stator for measuring the coil surface temperature of the stator and the temperature at a position 1.5 mm apart from the coil surface (the temperature of the molding composition when filled with molding composition). The thickness of the cured molding composition of a completed molded part is about 15 mm at the position for measuring the coil surface temperature.

The stator was preheated to 90°C , and the heated stator was set in a die heated to 150°C . The molding composition 1 was transferred into the die in which the stator was set. While the die was filled with the molding composition 1 by completely covering the stator, a direct-current voltage of 300 V was applied to the coil. When the coil surface temperature reached 150°C (30 seconds after filling with the molding composition), power feeding was stopped. When the temperature in the molding composition reached the maximum value (170°C) (75 seconds after filling with the molding composition), the

die was opened and the molded part was taken out. Meanwhile, the temperature in the molding composition suddenly increased from about 120°C and reached the maximum value.

As comparative example 2, using the same molding composition 1 as in the embodiment, the same operation was carried out except for the process of feeding power to the coil. When the temperature in the molding composition reached the highest temperature (123 seconds after filling with the molding composition), the die was opened, and the molded part was taken out. Thus, the molded part of comparative example 2 was prepared...

Further, as comparative example 3, a molded part was prepared in same procedure except for the process of feeding power to the coil same as in comparative example 2. In this case, the molded product was taken out by opening the die at the same time as when the die was opened in the embodiment (75 seconds after filling with the molding composition).

The appearance of the obtained molded parts was observed.

Table 3 summarizes the time after filling with the molding composition, the coil surface temperature, and temperature changes of the molding composition. In the table, the measuring points C and M indicate the

temperature on the coil surface (C) and in the molding composition (M), respectively. At the time of 0 sec, the coil surface temperature and the temperature in the molding composition were about 80°C. This is because the molding composition at room temperature was transferred, and the coil surface temperature once dropped from 90°C to about 80°C as being cooled while setting the stator in the die, while the temperature in the molding composition was raised in the transfer process to reach about 80°C.

Table 3

Time	0sec		30sec		75sec		87sec		123sec	
Measuring point	C	M	C	M	C	M	C	M	C	M
Embodiment 2	80	77	150	116	150	170	—	—	—	—
Comparative example 2	82	78	101	94	122	115	126	120	150	170
Comparative example 3	81	80	103	95	124	118	—	—	—	—

In this embodiment, in 75 seconds after filling the die with the molding composition, the temperature of the molding composition at a point 1.5 mm remote from the coil surface reached the maximum temperature, and the molded part was taken out of the die at this time. The obtained molded part was free from crack or other defect on the appearance, and was sufficiently cured, and a complete molded part was obtained.

In the case of comparative example 2, in 123 seconds after filling with the molding composition, the temperature of the molding composition reached the highest temperature, and it took a longer time for curing.

In the case of comparative example 3, several cracks were found on the surface of the obtained molded part, and complete molded part was not obtained.

The following fact is known from these results.

After the die containing the electronic component was filled with the molding composition, by feeding power to the coil of the buried electronic component and heating, curing of the molding composition can be promoted. In this embodiment, the curing time was shortened by about 40%.

Embodiment 3

Other embodiment of the method of manufacturing molded parts of the invention is described below.

First, a method of manufacturing a molding composition is explained. By mixing 65 parts by weight of unsaturated alkyd composed of phthalic anhydride, fumaric anhydride and propylene glycol, 35 parts by weight of styrene, and 0.01 part by weight of methoxy hydroquinone as polymerization inhibitor, and stirring and dissolving at room temperature, mixture A was

obtained.

On the other hand, to 64 parts by weight of 2-hydroxyethyl methacrylate, 36 parts by weight of polydipropylene adipate as low shrinking agent was stirred and dissolved at room temperature, and mixture B was obtained.

By stirring and mixing 74 parts by weight of the mixture A, 26 parts by weight of the mixture B, and 1 parts by weight of 1,1-(t-butyl peroxy) 3,3,5-trimethyl cyclohexane as polymerization initiator, a liquid resin composition was obtained.

Next, using a kneader, 17.8 parts by weight of calcium carbonate as filler, 48.5 parts by weight of aluminum hydroxide, 1.5 parts by weight of zinc stearate as parting agent, and 0.4 part by weight of carbon powder as coloring matter was mixed in dry process for 5 minutes. In this way, a uniformly blended dry mixture was obtained. To 68.2 parts by weight of this mixture, 22 parts by weight of the previously mixed liquid resin composition was gradually added and kneaded, and a uniform paste mixture was obtained.

To 90.2 parts by weight of this paste mixture, 9.8 parts by weight of glass fiber was uniformly dispersed and added in a short time, and kneading was finished when the glass fiber was wetted and dispersed uniformly. Thus

molding composition 2 was prepared.

By changing the liquid resin composition of the molding composition 2 as follows, molding composition 3 was prepared in the same composition and method in the other respects.

First, 63.5 parts by weight of unsaturated alkyd composed of phthalic anhydride, fumaric anhydride and propylene glycol, 27 parts by weight of styrene, 9.5 parts by weight of 2-hydroxyethyl methacrylate, and 0.01 part by weight of methoxy hydroquinone as polymerization inhibitor were mixed, and stirred and dissolved at room temperature. Thus, mixture C was obtained.

On the other hand, 36 parts by weight of polydipropylene adipate as low shrinking agent was stirred and dissolved at room temperature in 64 parts by weight of 2-hydroxyethyl methacrylate, and mixture D was obtained.

By stirring and mixing the mixture C, 26 parts by weight of the mixture D, and 1 part by weight of 1,1-(t-butyl peroxy) 3,3,5-trimethyl cyclohexane, a liquid resin composition was obtained. Mixing this liquid resin composition with the same various fillers as mentioned above, molding composition 3 was prepared.

Using these two kinds of molding composition 2 and molding composition 3, molded parts were prepared in the

same condition as in embodiment 2.

Table 4 summarizes the time from injection of the molding composition into the die, the coil surface temperature, and temperature changes in the molding composition. Table 4 also shows the result of experiment of the molding composition 1 explained in embodiment 2. In the molding compositions 1, 2, 3, the ratio of 2-hydroxyethyl methacrylate to styrene is 100:0, 65:35, and 50:50, respectively.

In the case of using the molding composition 2, in 55 seconds after filling with the molding composition, the temperature in the molding composition reached the highest temperature, and the die was opened and the molded part was taken out.

In the case of using the molding composition 3, in 45 seconds after filling with the molding composition, the temperature in the molding composition reached the highest temperature, and the die was opened and the molded part was taken out.

Table 4

Time Measuring point	0sec		30sec		45sec		55sec		75sec	
	C	M	C	M	C	M	C	M	C	M
Molding composition 1	80	77	150	116	152	134	151	146	150	170
Molding composition 2	83	77	148	118	153	151	151	171	—	—
Molding composition 3	82	79	151	120	153	168	—	—	—	—

All of the obtained molded parts were free from crack on the appearance, and complete molded parts were obtained. Besides, as the rate of replacing styrene in the molding composition with 2-hydroxyethyl methacrylate was increased, the time of the temperature in the molding composition required to reach the maximum temperature was shorter, and the curing time was shortened.

Embodiment 4

In this embodiment, the molding composition 3 in embodiment 3 was used. As the electronic component having the coil, the stator winding the coil differently from embodiment 2 was used. A schematic perspective view of the stator used in the embodiment is shown in Fig. 2. In this stator, the coil 5 was wound on the iron core 4 of 51 mm in inner diameter, 86 mm in outer diameter and 11 mm in laminate thickness by the number of turns as specified in Table 5.

Table 5

Winding division	Wire type	Copper wire dia.	No. of turns
Winding	1 UEW	ϕ 0.45	175

The surface temperature of the coil 5 is the

temperature in the intermediate space of mutually adjacent coils (the temperature measuring position 6 in Fig. 2), and a thermometer was attached to the stator for measuring the temperature in this area. The measuring position 6 is to measure the temperature of the molding composition when filled with the molding composition. The thickness of the cured resin layer of the obtained molded part is about 14 mm in the area for measuring the coil surface temperature.

The stator was preheated to 90°C , and the heated stator was set in a die heated to 150°C . The molding composition 3 was transferred into the die in which the stator was set. While the die was filled with the molding composition 3 by completely covering the stator, a direct-current voltage of 300 V was applied to the coil to heat it. When the coil surface temperature reached 150°C (82 seconds after filling with the molding composition), power feeding was stopped. When the temperature in the molding composition reached the maximum value (about 170°C) (127 seconds after filling with the molding composition), the die was opened and the molded part was taken out. Meanwhile, the temperature in the molding composition suddenly increased from about 120°C and reached the maximum value.

As comparative example 4, the same operation was

carried out except for the process of feeding power to the coil. When the temperature in the molding composition reached the highest temperature (163 seconds after filling with the molding composition), the die was opened, and the molded part was taken out. Thus, the molded part of comparative example 4 was prepared.

Further, as comparative example 5, a molded part was prepared in same procedure except for the process of feeding power to the coil same as in comparative example 4. In this case, the molded product was taken out by opening the die at the same time as when the die was opened in embodiment 4 (127 seconds after filling with the molding composition).

The appearance of the obtained molded parts was observed.

Table 6 summarizes the time after filling with the molding composition, the coil surface temperature, and temperature changes of the molding composition.

In the table, the measuring points C and M indicate the temperature on the coil surface (C) and in the molding composition (M), respectively.

Table 6

Time	0sec		82sec		127sec		132sec		163sec	
Measuring point	C	M	C	M	C	M	C	M	C	M
Embodiment 4	82	76	151	122	153	167	—	—	—	—
Comparative example 4	81	74	99	92	118	112	123	121	152	166
Comparative example 5	82	75	101	94	119	114	—	—	—	—

In this embodiment, in 127 seconds after filling with the molding composition, the temperature of the molding composition reached the maximum temperature, and the molded part was taken out of the die at this time. The obtained molded part was free from crack or other defect on the appearance, and was sufficiently cured, and a complete molded part was obtained.

In the case of comparative example 4, in 163 seconds after filling with the molding composition, the temperature of the molding composition reached the highest temperature, and it took a longer time for curing. However, there was no problem in the appearance of the molded part.

In the case of comparative example 5, several cracks were found on the obtained molded part, and complete molded part was not obtained.

As known from the results, after filling the electronic component with the molding composition, by

feeding power to the coil of the buried electronic component and heating, curing of the molding composition can be promoted. In this embodiment, the curing time was shortened by about 20%.

In the above embodiments, as the part having the coil by winding a conductive wire, the stator of a motor was used, but not limited to this, the transformer part having a coil winding a conductive wire is usable. As the thermosetting resin, unsaturated polyester was used, but not limited to this, epoxy resin and phenol resin are also usable.

Thus, the curing time can be shortened by the molding composition of the invention. As a result, the molding cycles within a specific time are increased, and the productivity is enhanced. Also by the method of manufacturing molded parts of the invention, the curing reaction of the resin is promoted, and the curing time is substantially shortened.

By the use of unsaturated polyester containing at least one of 2-hydroxyethyl acrylate or 2-hydroxyethyl methacrylate, the above effects are particularly excellent. Such method of manufacturing the molding composition and molded parts can be easily executed, and the productivity of parts can be enhanced notably.

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CLAIMS

1. A molding composition comprising:
 an unsaturated alkyd resin, and
 a crosslinking monomer to may be crosslinked to
 said unsaturated alkyd resin,

wherein said crosslinking monomer includes a first
 crosslinking monomer having $\begin{array}{c} | \\ \text{C}=\text{C} \\ | \end{array}$ group, $[-\text{CO}_2-]$ group,
 and $[-\text{OH}]$ group.

2. A molding composition of claim 1, wherein said
 first crosslinking monomer having said $\begin{array}{c} | \\ \text{C}=\text{C} \\ | \end{array}$ group,
 $[-\text{CO}_2-]$ group, and $[-\text{OH}]$ group has $\begin{array}{c} | \\ \text{C}=\text{CCO}_2- \\ | \end{array}$ group and
 $[-\text{OH}]$ group.

3. A molding composition of claim 2, wherein said
 first crosslinking monomer is at least one of 2-
 hydroxyethyl acrylate and 2-hydroxyethyl methacrylate.

4. A molding composition of claim 3, wherein the
 content of said first crosslinking monomer is in a range
 of about 1 mol.% to about 80 mol.% of the crosslinking
 monomer.

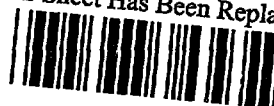
5. A molding composition of any one of claims 1,
 2, 3 or 4, wherein said crosslinking monomer further
 includes a second crosslinking monomer containing



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styrene.

6. A molding composition of any one of claims 1, 2, 3 or 4, wherein said crosslinking monomer further includes a second crosslinking monomer containing styrene, and the total content of said styrene and said first crosslinking monomer is about 90 mol.% or more of said crosslinking monomer.

7. A molding composition of claim 1, wherein said unsaturated alkyd resin is generated by chemical reaction of unsaturated polybasic acid, saturated polybasic acid and glycol.

8. A molding composition of claim 1, further comprising at least one selected from the group consisting of reaction initiator, filler, reinforcing material, low shrinking agent, coloring matter, thickener, and parting agent.

9. A molding composition of any one of claims 1, 2, 3 or 4, wherein a cured molded part is generated by the reaction of said unsaturated alkyd resin and said crosslinking monomer.

10. A molding composition of any one of claims 1, 2, 3 or 4, wherein an electronic component is buried so as to be covered therein, and a cured molded part is generated by the reaction of said unsaturated alkyd resin and said crosslinking monomer.

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11. A molded part comprising:

(a) a cured resin of a molding composition comprising

(1) an unsaturated alkyd resin, and

(2) a crosslinking monomer to may be crosslinked to said unsaturated alkyd resin,

in which said crosslinking monomer

includes a first crosslinking monomer having $\begin{array}{c} | \\ \text{C}=\text{C} \\ | \end{array}$ group,

$[-\text{CO}_2-]$ group, and $[-\text{OH}]$ group, and

(b) an electronic component installed as being covered with said cured resin.

12. A molded part of claim 11, wherein said first crosslinking monomer is at least one of 2-hydroxyethyl acrylate and 2-hydroxyethyl methacrylate.

13. A molded part of claim 12, wherein said crosslinking monomer further includes a second crosslinking monomer containing styrene.

14. A molded part of claim 13, wherein the content of said first crosslinking monomer is in a range of about 1 mol.% to about 80 mol.% of the total of said first crosslinking monomer and said second crosslinking monomer.

15. A molded part of claim 11, wherein said electronic component has a property capable of generating



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heat, and as power is fed to said electronic component, said electronic component generates heat, and by said heat, said unsaturated alkyd resin and said crosslinking monomer react to generate said cured resin.

16. A molded part of claim 15, wherein said electronic component has a coil formed by winding a conductive wire, and by power feeding to said coil, said coil generates heat.

17. A molded part of claim 15, wherein said electronic component is a stator of a motor, and said stator has a coil formed by winding a conductive wire, and by power feeding to said coil, said coil generates heat.

18. A molded part of claim 15, wherein said electronic component is a transformer having a coil formed by winding a conductive wire, and by power feeding to said transformer, said coil generates heat.

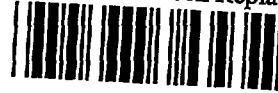
19. A method of manufacturing molded product comprising the steps of:

(a) covering the surrounding of an electronic component that can be heated with a molding composition,

(b) feeding power to said electronic component for generating heat in said electronic component, and

(c) curing said molding composition by said heat generated in said electronic component.





20. A method of manufacturing molded product of claim 19, wherein said electronic component has a coil formed by winding a conductive wire, and by power feeding to said coil, said coil generates heat.

21. A method of manufacturing molded product of claim 19, wherein said molding composition comprises an unsaturated alkyd resin, and a crosslinking monomer to may be crosslinked to said unsaturated alkyd resin, and said crosslinking monomer includes a first crosslinking monomer having $\begin{array}{c} | \\ [C=C] \\ | \end{array}$ group, $[-CO_2-]$ group, and $[-OH]$ group.

22. A method of manufacturing molded product of claim 21, wherein said first crosslinking monomer is at least one of 2-hydroxyethyl acrylate and 2-hydroxyethyl methacrylate.

23. A method of manufacturing molded product of any one of claims 20, 21 or 22, wherein said crosslinking monomer further includes a second crosslinking monomer containing styrene.

24. A method of manufacturing molded product of claim 22, wherein the content of said first crosslinking monomer is in a range of about 1 mol.% to about 80 mol.% of the crosslinking monomer.

25. A method of manufacturing molded product of



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claim 19, further comprising at least one selected from the group consisting of reaction initiator, filler, reinforcing material, low shrinking agent, coloring matter, thickener, and parting agent.

26. A method of manufacturing molded product of claim 21, wherein said electronic component is a stator of a motor, and said stator has a coil formed by winding a conductive wire, and by power feeding to said coil, said coil generates heat.

27. A method of manufacturing molded product of claim 21, wherein said electronic component is a transformer having a coil formed by winding a conductive wire, and by power feeding to said transformer, said coil generates heat.



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