

DESCRIPTION

RESIN COMPOSITION FOR RECOVERING MOLD RELEASABILITY AND
METHOD FOR RECOVERING MOLD RELEASABILITY

TECHNICAL FIELD

[0001]

The present invention relates to a mold conditioning resin composition used in molding a curing resin molding compound for imparting release properties to a mold surface from which stains have been removed. The present invention also relates to a mold conditioning method using the mold conditioning resin composition. By use of

10 the mold conditioning resin composition of the present invention, excellent release properties are imparted to the mold surface and it becomes possible to carry out encapsulation with a molding compound consecutively for a long period of time.

BACKGROUND ART

[0002]

15 When integrated circuits and the like are encapsulated and molded with a thermosetting molding compound such as an epoxy-resin molding compound and the like, a release agent contained in the thermosetting molding compound oozes out to the interface between the molded article and the mold and, thus, imparts release properties to the cull, cavity, and runner portions. When such molding is repeated many times,

20 troubles often arise such that the release of the molded articles worsen drastically, roughness and the like appear on the surface of the molded articles, damaging the appearance thereof, and defects occur in the printing process after the molding.

The reason for these troubles is thought to be that the release agent contained in the molding compound sequentially accumulates on the mold surface with repeated

25 molding at high temperature and gradually degrades by oxidation to form a hard layer of an oxidation-degraded release agent.

In order to avoid such a situation, therefore, mold cleaning is performed. However, even though the mold surface becomes clean after the cleaning, there has been a problem that the release agent on the mold surface is also removed and that the

mold release properties become extremely poor in the molding immediately after the cleaning. Thus, after the use of a mold cleaning compound, it was necessary to restore mold release properties by molding a mold conditioning resin composition and making the release agent contained therein transfer to the mold surface.

5 [0003]

In order to restore the mold release properties, the Patent Document 1 discloses a method for restoring the mold release properties promptly by heat molding a molding compound comprising at least one kind of release agent selected from the group consisting of more than 10 parts by weight of metal soaps, more than 5 parts by weight
10 of waxes, and at least 0.5 part by weight of oligomers and making the release agent transfer from the resin to the mold surface. It is claimed that, in this way, the cumbersome work such as spraying the release agent onto the mold surface can be eliminated. However, according to this method, the number of times the encapsulation molded articles could be molded consecutively after restoring the release properties was
15 very limited.

[0004]

On the other hand, with the ever increasing integration scale and decreasing device thickness and the spreading use of surface mount technology in integral circuits and the like (IC, LSI) fabrication, the shape and structures of molded articles have been
20 increasingly diversified. To cope with this, fluidity of a molding compound for semiconductor encapsulation has been improved. Even though these compounds for encapsulation are designed to be highly fluid, they have poor mold-release properties and tend to stain the mold surface, giving rise to a new problem of poor productivity. Thus, the mold cleaning and, consequently, the mold conditioning have come to be
25 performed frequently. Therefore, there has been a desire for a mold conditioning resin composition which, after cleaning of the mold, restores mold release properties that last long and makes possible many consecutive shots of molding of encapsulation molded articles.

[0005]

30 Patent Document 1: Japanese Patent Laid-Open Publication No. S48-79849

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0006]

5 An object of the present invention is to provide a mold conditioning resin composition which can overcome the aforementioned problem of frequent cleaning and conditioning of the mold, caused by high fluidity of the molding compounds for semiconductor encapsulation. Namely, an object of the present invention is to provide a mold conditioning resin composition which, after conditioning of the mold, restores mold release properties that last long and makes possible many consecutive shots of
10 molding of encapsulation molded articles.

MEANS FOR SOLVING THE PROBLEMS

[0007]

15 The present invention has been made to address the aforementioned problems and provides a mold conditioning resin composition which, in molding a curing resin molding compound, imparts release properties to a mold surface after removal of stains therefrom and which comprises melamine resin, at least one kind of metal soap-based release agent, and a fatty acid ester-based release agent and/or a synthetic wax. The mold conditioning resin composition can make possible long-lasting consecutive molding of encapsulation molded articles after restoring mold release properties.

20 The mold conditioning resin composition of the present invention can be formulated as one of a compression type which, in molding a curing resin molding compound, imparts release properties to a mold surface after removal of stains from the mold surface and the parting area of the mold. The mold conditioning resin composition can impart release properties even to the air vent portion and, after
25 restoring mold release properties, makes possible long-lasting consecutive molding of encapsulation molded articles.

EFFECT OF THE INVENTION

[0008]

30 The mold conditioning resin composition of the present invention exhibits restoring effect of mold release properties, containing a metal soap-based release agent, and a fatty acid ester-based release agent and/or a synthetic wax, with a melamine resin. Thus, the composition makes possible a long-lasting consecutive molding of

encapsulation molded articles after conditioning of the mold. Further, when the composition is formulated as a compression type, it imparts release properties even to the air vent portion and makes possible a long-lasting consecutive molding of encapsulation molded articles after restoring mold release properties.

5 BEST MODE FOR CARRYING OUT THE INVENTION
[0009]

Hereafter, the mold conditioning resin composition of the present invention will be described in more detail.

10 The melamine resin used in the present invention may be produced by a known method.

For example, formaldehyde and melamine crystals are reacted in a molar ratio of 1:1 to 4:1, advantageously 1.5:1 to 3:1, in an aqueous solution to produce an aqueous solution of the initial condensate. The reaction proceeds at a melamine crystal concentration of 20 to 60 % at a reaction temperature of 70 to 100°C under weakly
15 alkaline conditions, and completes in 10 to 100 minutes. Part of the formaldehyde may be replaced with an aldehyde component other than paraformaldehyde and formaldehyde such as an aliphatic aldehyde, for example, acetaldehyde.

[0010]

20 The mold conditioning resin composition of the present invention contains, as release agents, a metal soap-based release agent, and a fatty acid ester-based release agent and/or a synthetic wax, in addition to the melamine resin.

Examples of the metal soap-based release agent include calcium stearate, zinc stearate, zinc myristate, and the like.

25 Examples of the fatty acid ester-based release agent include a partially saponified montanic acid ester, a polymeric complex ester, and the like, and examples of the synthetic wax include a modified hydrocarbon wax, a mineral oil-based synthetic wax, and the like. Specifically, commercial products such as Licowax OP (a partially saponified montanic acid ester, produced by Clariant (Japan) K.K.), Loxiol G 78 (a

polymeric complex ester, produced by Cognis Japan Ltd.), Licolub H-4 (a modified hydrocarbon-based wax, produced by Clariant (Japan) K.K.), Loxiol VPN 881 (a mineral oil-based synthetic wax, produced by Cognis Japan Ltd.), and the like may be mentioned.

5 The amount of the metal soap-based release agent and the amount of the other release agents (the fatty acid ester-based release agent and synthetic wax) contained preferably fills the weight ratio (the former : the latter) of 90:10 to 30:70 and more preferably 80:20 to 40:60. An excessive content of other release agents is not preferable because it impairs the consecutive moldability.

10 The total amount of the metal soap-based release agent and other release agents is preferably 0.2 to 5.0 parts by weight and more preferably 0.5 to 3.0 parts by weight, per 100 parts by weight of the melamine resin. Too small an amount of the release agent results in reduction in the mold release properties. Too large an amount thereof, while the mold release properties are good, brings about a marked reduction in the
15 fluidity of the molten conditioning resin composition, resulting in poor moldability and also causes an increase in the number of dummy shots after the mold conditioning process.

[0011]

20 In order to improve handling in removing the molded article from the mold, it is desirable to add pulp to the mold conditioning resin composition of the present invention in addition to the melamine resin and the release agents. Examples of the pulp used include straw pulp, bamboo pulp, and wood pulp (soft wood pulp, hard wood pulp), each of which may be either chemical pulp or mechanical pulp.

25 Further, the pulp may be used in a form of pulp impregnated with the melamine resin, the essential component of the mold conditioning resin composition of the present invention (resin-impregnated pulp). The resin impregnated pulp may be prepared by, for example, impregnating the pulp with an aqueous solution of a melamine-formaldehyde resin followed by drying. Further, a portion or all of the pulp may be replaced with powdered pulp, so that the fluidity of the resin composition may
30 be adjusted as appropriate.

The size of the pulp is not particularly limited but usually ranges from about 5 to 1000 μm and preferably about 10 to about 200 μm . Further, the amount of the pulp to be added is usually 5 to 70 parts by weight and preferably 20 to 60 parts by weight, per 100 parts by weight of the melamine resin. Addition of less than 5 parts by weight of the pulp produces no effect. Addition of more than 70 parts by weight of the pulp impairs the fluidity in use, so that there arises a phenomenon that the mold conditioning resin composition fails to fill the extremities of a mold, and thus there cannot be imparted sufficient release properties all over the mold.

[0012]

Further, the mold conditioning resin composition of the present invention preferably contains a curing catalyst. Examples of the curing catalyst include an organic acid such as phthalic anhydride, oxalic acid, sulfamic acid, p-toluenesulfonic acid, and the like; an inorganic acid such as hydrochloric acid, sulfuric acid, and the like; the salts of these acids with triethylamine, triethanolamine, β -dimethylaminoethanol, 2-methyl-2-amino-1-propanol, and the like. The amount of the curing catalyst added is usually 0.05 to 1.5 parts by weight, and preferably 0.1 to 1 part by weight, per 100 parts by weight of the melamine resin.

The mold conditioning resin composition of the present invention preferably contains at least one selected from the pulp and the curing catalyst.

Further, the mold conditioning resin composition of the present invention may contain, as appropriate, a colorant such as a pigment and the like, a fibrous filler other than pulp, an inorganic filler having a low hardness and small particle size, and the like.

Examples of the colorant include an inorganic pigment such as titanium dioxide, carbon black, zinc oxide, ferric oxide, and the like; an organic pigment such as phthalocyanines, azo compounds, diazo compounds, and the like; a fluorescent pigment such as benzoxazoles, naphthotriazoles, coumarins, and the like; a dye such as anthraquinones, indigos, azo compounds, and the like. Examples of the fibrous filler include wood powder, a natural fiber such as cotton, hemp, cotton linter, and the like; a chemical fiber such as an aramid fiber, a vinylon fiber, a polyester fiber, and the like. Examples of the inorganic filler include glass powder, a glass fiber, silica powder, untreated calcium carbonate, talc, aluminum hydroxide, barium sulfate, zinc sulfide,

calcium sulfate, and the like.

[0013]

The mold conditioning resin composition of the present invention may be formulated as a compression type and also as a transfer type.

5 When the composition is formulated as a compression type, it is preferable to compound pulp, a curing catalyst, an antioxidant, and the like in addition to the essential components, that is, a melamine resin, a metal soap-based release agent, and a fatty acid ester-based release agent and/or a synthetic wax. An example of a preferable formulation of a compression type mold conditioning resin composition is shown
10 below.

[Formulation example of a compression type composition]

	Melamine resin	100 parts by weight
	Metal soap-based release agent	0.3 to 1.0 part by weight
	Fatty acid ester-based release agent and/or synthetic wax	
15		0.5 to 1.5 parts by weight
	Pulp	20 to 40 parts by weight
	Curing catalyst	0.02 to 0.50 part by weight

To prepare a composition of a compression type, a preferable combination of the metal soap-based release agent, and fatty acid ester-based release agent and/or synthetic
20 wax includes the combination of zinc stearate and a partially saponified montanic acid ester, the combination of calcium stearate and a modified hydrocarbon wax, the combination of calcium stearate and a polymeric complex ester, and the like.

[0014]

Further, when the composition is formulated as a transfer type, it is preferable to
25 compound a fibrous filler such as pulp and the like, a curing catalyst, an inorganic filler such as silica powder and the like, a colorant, an antioxidant, and the like, in addition to the essential components, e.g., a melamine resin, a metal soap-based release agent, and a fatty acid ester-based release agent and/or a synthetic wax. An example of a preferable formulation of a transfer type mold conditioning resin composition is shown

below.

[Formulation example of a transfer type composition]

	Melamine resin	100 parts by weight
	Metal soap-based release agent	0.3 to 1.0 part by weight
5	Fatty acid ester-based release agent and/or synthetic wax	0.5 to 1.5 parts by weight
	Pulp	5 to 20 parts by weight
	Curing catalyst	0.02 to 0.1 part y weight
	Silica powder	10 to 40 parts by weight

10 To prepare a composition of a transfer type, a preferable combination of the metal soap-based release agent, and fatty acid ester-based release agent and/or a synthetic wax includes the combination of zinc stearate and a partially saponified montanic acid ester, the combination of zinc stearate and a modified hydrocarbon wax, the combination of calcium stearate and a mineral oil-based synthetic wax, and the like.

15 [0015]

To prepare the mold conditioning resin composition of the present invention, any means may be employed as long as it can homogenously blend the melamine resin, the metal soap-based release agent, the fatty acid ester-based release agent and/or synthetic wax, and other additives such as pulp and the like.

20 For example, there may be mentioned a kneader, a ribbon blender, a Henschel mixer, a ball mill, a roll mill, an automated motor, a tumbling mixer, and the like.

[0016]

25 The curing resin molding compound for which the mold release properties are restored by use of a mold conditioning resin composition of the present invention is exemplified by an epoxy-resin molding compound, a phenol-resin molding compound, and the like. Among these, preferable is the epoxy-resin molding compound, especially the one for semiconductor encapsulation. Further, while the mold conditioning resin composition of the present invention is applicable to any mold that is used for automatically molding the curing resin molding compound, it is

advantageously applied to molds made of iron, chromium, and the like.

By molding the mold conditioning resin composition of the present invention in the mold, it is possible to impart release properties to the mold surface. The preferable molding conditions for the mold conditioning resin composition of the present invention are: a mold temperature of 160 to 190°C, a molding pressure of 10 to 20 MPa, and a curing time of 2 to 3 minutes.

EXAMPLES

[0017]

Hereafter, the present invention will be further described in greater detail with reference to Examples, but it should be understood that the present invention is not deemed to be limited thereto.

[0018]

Preparation Example 1

A mixture of 480 parts by weight of melamine, 520 parts by weight of formalin (a 37% aqueous solution), and 350 parts by weight of water was heated and reacted to give a melamine-formaldehyde resin in a known manner. To the aqueous melamine resin solution obtained was added 257 parts by weight of pulp, and the resultant mixture was kneaded and vacuum-dried to give pulp-loaded melamine-formaldehyde resin powder (melamine resin-impregnated pulp) with a resin content of about 73%.

[0019]

Preparation Example 2

The aqueous melamine resin solution obtained in Preparation Example 1 (solid content: ca. 60 weight %) was dried at about 200°C by a spray drier to give a powdered melamine resin.

[0020]

Example 1

A mold conditioning resin composition A was obtained by blending in a ball mill 30 parts by weight of the pulp-loaded melamine-formaldehyde resin powder with a resin content of about 73% prepared in Preparation Example 1, 50 parts by weight of

the powdered melamine resin prepared in Preparation Example 2, 20 parts by weight of silica powder with a particle size of # 200, 0.2 part by weight of benzoic acid, 0.3 part by weight of zinc stearate, 0.3 part by weight of ethylenebisstearamide, and 0.35 part by weight of Licowax OP (partially saponified montanic acid ester produced by Clariant (Japan) K.K.). As is shown in Table 1, the mold conditioning resin composition A obtained showed excellent mold release properties. Further, when an epoxy-resin molding compound for encapsulation was molded after restoring release properties using the mold conditioning resin composition A, excellent consecutive moldability was exhibited.

10 [0021]

Example 2

Except that 0.1 part by weight of Loxiol G 78 (a polymeric complex ester, produced by Cognis Japan Ltd.) was used instead of 0.35 part by weight of Licowax OP (a partially saponified montanic acid ester, produced by Clariant (Japan) K.K.), a mold conditioning resin composition B was obtained in the same manner as in Example 1. As is shown in Table 1, the mold conditioning resin composition B obtained showed excellent mold release properties. Further, when an epoxy-resin molding compound for encapsulation was molded after restoring release properties using the mold conditioning resin composition B, excellent consecutive moldability was exhibited.

20 [0022]

Example 3

Except that 0.35 part by weight of Licolub H-4 (a modified hydrocarbon, produced by Clariant (Japan) K.K.) was used instead of 0.35 part by weight of Licowax OP (a partially saponified montanic acid ester, produced by Clariant (Japan) K.K.), a mold conditioning resin composition C was obtained in the same manner as in Example 1. As is shown in Table 1, the mold conditioning resin composition C obtained showed excellent mold release properties. Further, when an epoxy-resin molding compound for encapsulation was molded after restoring release properties using the mold conditioning resin composition C, excellent consecutive moldability was exhibited.

[0023]

Example 4

Except that 0.30 part by weight of Loxiol VPN 881 (a mineral oil-based synthetic wax, produced by Cognis Japan Ltd.) was used instead of 0.35 part by weight of Licowax OP (a partially saponified montanic acid ester, produced by Clariant (Japan) K.K.), a mold conditioning resin composition D was obtained in the same manner as in Example 1. As is shown in Table 1, the mold conditioning resin composition D obtained showed excellent mold release properties. Further, when an epoxy-resin molding compound for encapsulation was molded after restoring release properties using the mold conditioning resin composition D, excellent consecutive moldability was exhibited.

[0024]

Test Example 1

Initialization of the mold

In carrying out the mold conditioning test with the mold conditioning resin compositions A to D, it is necessary that surface conditions of the mold before the test is made to be constant. Thus, the mold was cleaned by 5 shots of transfer molding of a commercially available melamine resin-based mold cleaning compound (Nikalet ECR-CL, produced by Nippon Carbide Industries Co., Inc.), followed by 2 shots of compression molding of a commercially available melamine resin-based mold cleaning compound (Nikalet ECR-SW7320, produced by Nippon Carbide Industries Co., Inc.).

Molding condition

Mold: QFP

Mold temperature: 175°C/175°C

Curing time: ECR-CL, 300 seconds

SW7320, 180 seconds

Mold conditioning test

After mold cleaning for initialization was complete, one of the mold conditioning resin compositions A to D was molded 3 shots by transfer molding with a curing time of 180 seconds. Subsequently, a commercially available biphenyl-type epoxy-resin molding compound (EME-7351T, produced by Sumitomo Bakelite Co., Ltd.) was molded, and the mold release properties and consecutive moldability were examined.

Molding condition

Mold: QFP

Mold temperature: 175°C/175°C

Curing time: 100 seconds

5 [0025]

[Table 1]

		Examples			
		1	2	3	4
Mold conditioning resin composition		A	B	C	D
Evaluation item	Mold release properties	Good	Good	Good	Good
	Consecutive moldability	> 1000 shots	> 1000 shots	> 1000 shots	> 1000 shots

Good: No sticking occurred at the cavity, gate, and air vent portions and the cured molded article was easily released from the mold.

[0026]

10 Example 5

Using a ball mill, 1000 parts by weight of the pulp-loaded melamine-formaldehyde resin powder obtained in Preparation Example 1 with a resin content of about 73%, 0.5 part by weight of phthalic anhydride, 2.5 parts by weight of zinc stearate, and 3.5 parts by weight of Licowax OP (a partially saponified montanic acid ester, produced by Clariant (Japan) K.K.) were blended to give a mold conditioning resin composition E. As is shown in Table 2, the mold conditioning resin composition E obtained showed excellent mold release properties. Further, when an epoxy-resin molding compound for encapsulation was molded after restoring release properties using the mold conditioning resin composition E, excellent consecutive moldability was exhibited.

[0027]

Example 6

Except that 1.0 part by weight of Loxiol G 78 (a polymeric complex ester, produced by Cognis Japan Ltd.) was used instead of 3.5 parts by weight of Licowax OP (a partially saponified montanic acid ester, produced by Clariant (Japan) K.K.), a mold conditioning resin composition F was obtained in the same manner as in Example 5.

As is shown in Table 2, the mold conditioning resin composition F obtained showed excellent mold release properties. Further, when an epoxy-resin molding compound for encapsulation was molded after restoring release properties using the mold conditioning resin composition F, excellent consecutive moldability was exhibited.

5 [0028]

Example 7

Except that 3.5 parts by weight of Licolub H-4 (a modified hydrocarbon, produced by Clariant (Japan) K.K.) was used instead of 3.5 parts by weight of Licowax OP (a partially saponified montanic acid ester, produced by Clariant (Japan) K.K.), a mold conditioning resin composition G was obtained in the same manner as in Example 5. As is shown in Table 2, the mold conditioning resin composition G obtained showed excellent mold release properties. Further, when an epoxy-resin molding compound for encapsulation was molded after restoring release properties using the mold conditioning resin composition G, an excellent consecutive moldability was exhibited.

[0029]

Example 8

Except that 3.0 parts by weight of Loxiol VPN 881 (a mineral oil-based synthetic wax, produced by Cognis Japan Ltd.) was used instead of 3.5 parts by weight of Licowax OP (a partially saponified montanic acid ester, produced by Clariant (Japan) K.K.), a mold conditioning resin composition H was obtained in the same manner as in Example 5. As is shown in Table 2, the mold conditioning resin composition H obtained showed excellent mold release properties. Further, when an epoxy-resin molding compound for encapsulation was molded after restoring release properties using the mold conditioning resin composition H, excellent consecutive moldability was exhibited.

[0030]

Test Example 2

Initialization of the mold

30 The mold was cleaned in the same manner as in Test Example 1.

Mold conditioning test

After mold cleaning for initialization was complete, one of the mold conditioning resin compositions E to H was molded 3 shots by compression molding with a curing time of 180 seconds. Subsequently, a commercially available
 5 biphenyl-type epoxy-resin molding compound (EME-7351T, produced by Sumitomo Bakelite Co., Ltd.) was molded, and the mold release properties and consecutive moldability were examined.

Molding condition

Mold: QFP

10 Mold temperature: 175°C/175°C

Curing time: 100 seconds

[0031]

[Table 2]

		Examples			
		5	6	7	8
Mold conditioning resin composition		E	F	G	H
Evaluation item	Mold release properties	Good	Good	Good	Good
	Consecutive moldability	> 1000 shots	> 1000 shots	> 1000 shots	> 1000 shots

The evaluation criteria for the mold release properties are the same as in Table 1.

15 INDUSTRIAL APPLICABILITY

[0032]

Use of the mold conditioning resin composition according to the present invention enables excellent restoration of the mold release properties, thereby to make it possible to prevent sticking at the cavity portion, air vent portion, and the like caused by
 20 high functionalization of epoxy-resin molding compounds for encapsulation and by high sophistication of the semiconductor devices in recent years. Further, because the mold release properties are maintained for a long period of time, excellent consecutive moldability is exhibited, leading to productivity improvement.

CLAIMS

1. A mold conditioning resin composition to be used in molding a curing resin molding compound to impart release properties to a mold surface after removal of stains therefrom, comprising a melamine resin, at least one metal soap-based release agent,
5 and a fatty acid ester-based release agent and/or a synthetic wax, wherein the fatty acid ester-based release agent is a partially saponified montanic acid ester or a polymeric complex ester; the synthetic wax is a modified hydrocarbon-based wax or a mineral oil-based synthetic wax; the weight ratio of the amount of the metal soap-based release agent to the combined amount of the fatty acid ester-based release agent and the
10 synthetic wax (the former : the latter) is 90 : 10 to 30 : 70; and the total amount of the metal soap-based release agent, the fatty acid ester-based release agent, and the synthetic wax is 0.2 to 5.0 parts by weight per 100 parts by weight of the melamine resin.
2. The mold conditioning resin composition according to claim 1, wherein the resin
15 composition is of a compression type.
3. The mold conditioning resin composition according to claim 1, wherein the resin composition is of a transfer type.
4. The mold conditioning resin composition according to any of claims 1 to 3, further comprising at least one selected from pulp and a curing catalyst.
- 20 5. A mold conditioning method comprising using the mold conditioning resin composition according to any of claims 1 to 4.