

RESIN COMPOSITION FOR CLEANING DIE

Technical Field

[0001] The present invention relates to a resin composition for cleaning a die.

Background Art

[0002] In the case of performing sealing molding using a sealing molding material containing a thermosetting resin composition, continuing a long-term sealing molding operation of an integrated circuit, an LED element, or the like tends to cause a dirt originating from the sealing molding material. Such a dirt left in the die causes defects such as adhesion of the dirt onto a surface of a sealing-molded product such as an integrated circuit or an LED element or failure in separation of a sealing-molded product from a molding die. Therefore, it is necessary to remove the dirt on the molding die for performing sealing molding. Specifically, it is desirable to perform molding of a resin composition for cleaning a die instead of a sealing molding material at a rate of several shots based on several hundred shots of sealing molding. Dirt on an internal surface of the molding die may contact the resin material for cleaning a die by molding the resin composition with the molding dye, and cleaning of the die may be achieved by removing the resin composition to which the die is attached from the die.

[0003] Such a resin composition for cleaning a die has hitherto been proposed.

For example, Japanese Patent Application Laid-Open (JP-A) No. H08-57865 describes an amino-based resin composition for cleaning a die which contains a metal soap and a fatty acid amide-based lubricant.

According to JP-A No. H08-57865, the metal soap is involved in fluidity of a molten resin in the die. This amino-based resin composition for cleaning a die has enhanced tablet properties in formation of the resin composition. That is, difficulty in removal of the resin composition from the die when the resin composition is molded in a mini tablet shape is improved (decreased), and squeak noise or defects such as breakage and chips at the time of removing the resin composition can be inhibited.

[0004] International Patent Application No. 2002/30648 describes a resin composition for cleaning a die which contains a melamine-based resin and a fibrous inorganic compound of which an average fiber length, an average fiber diameter, and an aspect ratio each are within a specific range.

According to International Patent Application No. 2002/30648, this resin composition for cleaning a die can enhance workability of die cleaning and can clean contamination components on the surface of the die caused by repetition of molding using

various molding materials represented by a biphenyl-based epoxy resin or a polyfunctional epoxy resin. In addition, it describes that, in a case in which this resin composition for cleaning a die contains a metal soap represented by zinc myristate as a lubricant, die releasing property is maintained favorably and there is description that the content of the metal soap is preferably 1.5 parts by mass or less per 100 parts by mass of the resin composition for cleaning a die.

SUMMARY OF INVENTION

[0005] In recent years, for environmental conservation, a conventional sealing molding material, which contains compositions having a large environmental load and represented by lead, antimony, and halogen compounds, is being substituted by a sealing molding material, which is called a green compound, not containing such compounds. Specifically, a sealing molding material in which a conventional flame retardant is substituted by a metal hydroxide-based flame retardant or an organic phosphorus-based flame retardant or a sealing molding material capable of attaining flame retardation with designing or blending of an epoxy resin is called a green compound.

In addition, there is also an increasing tendency to use a sealing molding material having improved adhesiveness with a lead frame.

In a sealing and molding step using such a green compound or a sealing molding material having improved adhesiveness with a metal, the internal surface of the molding die easily dirties. For this reason, there is a demand for developing a resin composition for cleaning a die having higher cleaning performance.

[0006] When affinity of a resin composition for cleaning a die containing a large amount of metal soap to dirt on the internal surface of the molding die increases, cleaning performance is expected to be enhanced. The present inventors prepared a resin composition for cleaning a die based on the composition described in Example 1 of International Patent Application No. 2002/30648 by changing the content of metal soap to be added to the resin composition for cleaning a die from 0.5 part by mass of zinc stearate to 2.0 parts by mass of zinc myristate per 100 parts by mass of the resin composition for cleaning a die and using melamine-phenol-formaldehyde resin powder mixed with a hardwood pulp as a melamine-based resin-impregnated pulp, and evaluated cleaning performance of the prepared resin composition. As a result, this resin composition for cleaning a die exhibited excellent cleaning performance. However, the internal strength of the resin composition for cleaning a die is extremely low and has a problem that chipping (chips of the resin composition) occurs in a step of removing the resin composition from the molding die after cleaning the die and

the resin composition is not sufficiently removed from the molding die. In other words, there is a room for improvement in the die cleaning step using this resin composition for cleaning a die from the viewpoint of workability.

[0007] As a result of an extensive study, the inventors of the invention found that a resin composition for cleaning a die which contains a melamine-based resin, a specific amount of metal soap, a fibrous inorganic compound, and a softwood pulp, keeps die cleaning performance favorable and it is possible to inhibit chipping of the resin composition in the step of removing the resin composition from the molding die after cleaning.

[0008] The invention is made in view of the circumstances described above, and an object thereof is to provide a resin composition for cleaning a die which has favorable die cleaning performance and can improve workability in the removing step of removing the resin composition from the molding die after cleaning.

[0009] Specific means for achieving the problems described above are as follows.

<1> A resin composition for cleaning a die, the resin composition comprising: a melamine-based resin; a metal soap; a fibrous inorganic compound; and a softwood pulp, a content of the metal soap being from 1.6 parts by mass to 5.0 parts by mass per 100 parts by mass of the resin composition.

[0010] <2> The resin composition for cleaning a die according to <1>, wherein the metal soap is comprises a zinc salt of a fatty acid.

<3> The resin composition for cleaning a die according to <2>, wherein the zinc salt of a fatty acid comprises at least one selected from the group consisting of zinc myristate, zinc laurate, and zinc stearate.

[0011] <4> The resin composition for cleaning a die according to any one of <1> to <3>, wherein the fibrous inorganic compound is comprises a ceramic fiber.

[0012] <5> The resin composition for cleaning a die according to <4>, wherein the ceramic fiber comprises at least one selected from the group consisting of a potassium titanate fiber and an aluminum borate fiber.

<6> The resin composition for cleaning a die according to any one of <1> to <5>, wherein the melamine-based resin includes at least one selected from the group consisting of a melamine-formaldehyde resin and a melamine-phenol co-condensate.

<7> The resin composition for cleaning a die according to any one of <1> to <6>, wherein the softwood pulp is impregnated with the melamine-based resin.

[0013] According to the present disclosure, a resin composition for cleaning a die which has favorable die cleaning performance and can improve workability in a step of removing the resin composition from a molding die after cleaning may be provided.

DESCRIPTION OF EMBODIMENTS

[0014] Hereinafter, specific exemplary embodiments of the invention will be described in detail; however, the invention is not intended to be limited to the following exemplary embodiments, and the invention can be carried out by applying appropriate modification within the scope of the purpose of the present invention.

[0015] In the present specification, a notation of the numeric value ranges in the specification signifies a range that includes the numeric value represented as the lower limit value of the numeric value range as the minimum value, and that includes the numeric value represented as the upper limit value of the numeric value range as the maximum value.

In the case of mentioning of an amount of a certain component in a composition, in a case in which plural substances corresponding to the component are present in the composition, the amount means the total amount of the plural substances present in the composition, unless particularly otherwise defined.

The resin composition for cleaning a die may be simply referred to as "the resin composition" in some cases.

An "internal surface of a molding die" means a region of the molding die which contacts a subject to be molded by the molding die.

In addition, a molding die may be simply referred to as a "die" in some cases.

[0016] Resin composition for Cleaning Die

The resin composition for cleaning a die of the present disclosure contains at least: a melamine-based resin; a metal soap; a fibrous inorganic compound; and a softwood pulp, a content of the metal soap being from 1.6 parts by mass to 5.0 parts by mass per 100 parts by mass of the resin composition. The resin composition may further contain other component(s) according to necessity.

[0017] The resin composition of the present disclosure contains a melamine-based resin, a specific amount of metal soap, a fibrous inorganic compound, and a softwood pulp. Therefore, fluidity and die cleaning performance may be favorably maintained, and reduction of chipping occurring in the step of removing the resin composition attached with dirt from the molding die after cleaning may be expected. The reason for the effects can be considered as follows, for example.

[0018] Generally, when a large amount of a metal soap is included in a resin composition for cleaning a die containing a melamine-based resin, the internal strength of the resin composition for cleaning a die is extremely decreased, and thus the resin composition for cleaning a die becomes fragile (chipping easily occurs) in the operation of removing the resin

composition from a die after cleaning the die. Therefore, workability may be significantly lowered. It is known that a decrease in internal strength of the resin composition can be reduced by an additive such as a pulp. However, for example, in a case in which either a pulp or a fibrous inorganic compound is used singly as an additive, entanglement of the pulp or the fibrous inorganic compound in the resin composition for cleaning a die may not be sufficient, and thus the internal strength of the resin composition may be still low. In a case in which a hardwood pulp and a fibrous inorganic compound are used in combination, entanglement between the hardwood pulp and the fibrous inorganic compound may not be sufficient as fibers of the hardwood pulp are short and thin. Accordingly, the internal strength of the resin composition is still low. On the other hand, the resin composition of the present disclosure uses a softwood pulp and a fibrous inorganic compound are used in combination. Although specific mechanism is not clear, it is assumed that since the softwood pulp and fibrous inorganic compound are entangled with each other in the resin composition for cleaning a die, the internal strength of the resin composition can be sufficient so that occurrence of chipping of the resin composition in the step of removing the resin composition from the molding die after cleaning can be reduced even though a large amount of metal soap, that is, 1.6 parts by mass or more of a metal soap per 100 parts by mass of the resin composition for cleaning a die, is contained therein.

The internal strength of the resin composition can be evaluated by measuring the bending strength of the resin composition, for example, using a Tensilon.

[0019] Melamine-based resin

The resin composition for cleaning a die of the present disclosure includes at least one melamine-based resin.

The melamine-based resin herein referred to means a melamine resin, a melamine-phenol co-condensate resin, or a melamine-urea co-condensate resin.

At least one of these may be contained in the resin composition of the present disclosure.

[0020] The melamine resin is a condensate of a triazine and an aldehyde. Examples of the triazine include melamine, benzoguanamine, and acetoguanamine. Examples of the aldehyde include formaldehyde, paraformaldehyde, and acetaldehyde.

Hereinafter, a condensate of melamine and formaldehyde is referred to as a melamine-formaldehyde resin.

[0021] The melamine-phenol co-condensate resin is a co-condensate of a triazine, a phenol, and an aldehyde. Examples of the phenol include phenol, cresol, xlenol, ethylphenol, and butylphenol.

[0022] The melamine-urea co-condensate resin is a co-condensate of a triazine, a urea, and an aldehyde.

[0023] An amount of the triazine with respect to the total amount of the triazine and the phenol in a raw material for forming the melamine-phenol co-condensate resin and an amount of the triazine with respect to the total amount of the triazine and the urea in a raw material for forming the melamine-urea co-condensate resin may be respectively, for example, 30 % by mass or more, 40 % by mass or more, 50 % by mass or more, 60 % by mass or more, 70 % by mass or more, 80 % by mass or more, or 90 % by mass or more, but less than 100 % by mass.

The melamine resin and the melamine co-condensate resins may be obtained by reacting the triazine or a combination of the triazine and the co-condensation components with the aldehyde in a molar ratio of from about 1/1 to 3/1, that is preferably from about 1.5/1 to 2/1 ([aldehyde] / [triazine or the combination]).

Unless deteriorating the effect of the present disclosure, the resin composition for cleaning a die of the present disclosure may include, in addition to the melamine-based resin, another kind of resin such as one that includes at least one selected from the group consisting of an alkyd resin, a polyester resin, an acrylic resin, an epoxy resin, and a rubber.

[0024] The resin composition for cleaning a die of the present disclosure exhibits excellent performance for cleaning a dirt on an internal surface of a molding die because of including the melamine-based resin. Although the reason thereof is not completely clear, it is considered that the excellent performance of the resin composition for cleaning a die including the melamine-based resin is exhibited since the melamine-based resin has a methylol group, that has a high polarity, can react with a dirt that is generated in molding, adheres to an internal surface of a molding die, and originates from a sealing molding material (i.e., a dirt originating from a sealing molding material containing a thermosetting resin composition), so that the resin composition for cleaning a die of the present disclosure can exhibit the excellent performance. It is also considered that excellent cleaning performance can be stably exerted at from around 160°C to 190°C, which is the temperature in cleaning of a die, since the melamine-based resin is thermally stable.

[0025] Metal Soap

The resin composition of the present disclosure contains a metal soap.

The metal soap is a metal salt of a fatty acid composed of a fatty acid having from 12 to 20 carbon atoms and a metal selected from the group consisting of aluminum, calcium, zinc, and magnesium.

The metal soap contained in the resin composition of the present disclosure exhibits the effect as a lubricant of enhancing fluidity of the resin composition at the time of cleaning

so as to cause the melamine-based resin to easily act on dirt on the internal surface of the molding die, and the effect as a cleaning agent of directly acting on dirt by high affinity with dirt on the internal surface of the molding die.

[0026] The metal soap contained in the resin composition of the present disclosure is preferably a zinc salt of a fatty acid, which is represented by zinc stearate or zinc myristate. When the metal soap is a zinc salt of a fatty acid, the resin composition has high affinity with dirt on the internal surface of the molding die, which leads to high die cleaning performance that is favorable.

[0027] Examples of the metal soap contained in the resin composition of the present disclosure include zinc stearate, zinc myristate, zinc laurate, zinc palmitate, calcium stearate, aluminum stearate, and magnesium stearate.

[0028] A content of the metal soap contained in the resin composition of the present disclosure is from 1.6 parts by mass to 5.0 parts by mass per 100 parts by mass of the resin composition. The content of the metal soap is preferably from 1.8 parts by mass to 3 parts by mass and more preferably from 1.8 parts by mass to 2.3 parts by mass per 100 parts by mass of the resin composition.

When the amount of the metal soap contained in the resin composition is excessively large, the metal soap may excessively attach onto the internal surface of the molding die in the die cleaning step so that the metal soap remains thereon and becomes new dirt. That is, the resin composition having an excessive amount of metal soap may act in an opposite manner to the cleaning action, that is, an action of contaminating the internal surface of the molding die.

Since the content of the metal soap is 1.6 parts by mass or more per 100 parts by mass of the resin composition, the resin composition of the present disclosure may exhibit dramatically superior cleaning performance compared to a conventional resin composition by the effect as a lubricant and the effect as a cleaning agent as described above. Further, since the content of the metal soap is 5.0 parts by mass or less per 100 parts by mass of the resin composition, the metal soap may not substantially remain on the internal surface of the molding die after the resin composition is used for cleaning a die, cleaning performance may be favorable, the internal strength of the resin composition may not be decreased, and chipping may not occur after cleaning.

[0029] JP-A No. H08-57865 describes that a content of a lubricant, which is represented by the metal soap, in a resin composition is preferably 1.5 parts by mass or less per 100 parts by mass of the resin composition in order to enhance cleaning performance. On the other hand, die cleaning can be sufficiently performed even though the content of the metal soap contained in the resin composition of the present disclosure is 1.6 parts by mass or more per

100 parts by mass of the resin composition. The present inventors consider the reason as follows.

The resin composition of the present disclosure contains the softwood pulp and the fibrous inorganic compound. Therefore, the internal strength thereof can be sufficient due to the effect of entanglement between the softwood pulp and the fibrous inorganic compound as described above. For this reason, even though the metal soap affecting the weakening of the internal strength is contained in a large amount, the internal strength of the resin composition of the present disclosure is not reduced.

[0030] The kind and content of the metal soap contained in the resin composition of the present disclosure can be obtained by determining a metal kind and a fatty acid through a fluorescent X-ray analysis method and a gas chromatography mass spectroscopy analysis method.

[0031] Fibrous Inorganic Compound

The resin composition of the present disclosure contains a fibrous inorganic compound.

The fibrous inorganic compound is also known as an inorganic fiber, and examples thereof including a glass fiber, a metal fiber, and a ceramic fiber.

Examples of the metal fiber include steel fiber and stainless steel fiber.

Examples of the ceramic fiber include an alumina fiber, a silica fiber, a potassium titanate fiber, a calcium carbonate fiber, a calcium silicate fiber, an aluminum borate fiber, a silicon carbide fiber, a zirconia fiber, a silicon nitride fiber, a magnesium sulfate fiber, and a zinc oxide fiber.

The shape of the fibrous inorganic compound is not limited, and the cross-section thereof may be an exact circle or a flat shape. The average fiber length of the typical fibrous inorganic compound is in a range of from 5 μm to 30 μm , the average fiber diameter is in a range of from 0.1 μm to 1.0 μm , and the aspect ratio is in a range of from 10 to 60. Fiber length, fiber diameter and the aspect ratio of the fibrous inorganic compound can be determined by using an electronic microscope.

A single kind of the fibrous inorganic compound or a combination of two or more kinds of the fibrous inorganic compound may be used.

[0032] The fibrous inorganic compound contained in the resin composition of the present disclosure exhibits: the effect of acting on dirt on the internal surface of the molding die at the time of cleaning and enabling the resin composition and the dirt to adhere to each other; and the effect of enhancing the internal strength of the resin composition.

[0033] A ceramic fiber is preferably used as the fibrous inorganic compound contained in

the resin composition of the present disclosure.

When the fibrous inorganic compound is a ceramic fiber, the above-described effects can be particularly remarkably obtained and scratches on the surface of the die cleaned by the fibrous inorganic compound at the time of cleaning can be extremely reduced, which is favorable.

The surface of the ceramic fiber is preferably subjected to surface treatment by using, for example, a silane coupling agent such as an epoxy silane-based coupling agent, an amino silane-based coupling agent, or a methacryloxy silane-based coupling agent, or various resins. When the resin composition of the present disclosure contains a surface-treated ceramic fiber, adhesiveness between the fibrous inorganic compound and the melamine-based resin may be enhanced, and thus the internal strength of the resin composition may be further enhanced.

[0034] As the ceramic fiber, for example, ALBOREX Y, ALBOREX M20, ALBOREX YS3A, ALBOREX YS2B, and ALBOREX YS4 (product names, manufactured by Shikoku Chemicals Corporation) as aluminum borate fiber, TISMO D, TISMO L, TISMO D101, and TISMO D102 (product names, manufactured by Otsuka Chemical Holdings Co., Ltd.) as potassium titanate fiber, MOS-HIGE (product name, manufactured by Ube Industries, Ltd.) as magnesium sulfate fiber, WHISCAL A (product name, manufactured by Maruo Calcium Co., Ltd.) as calcium carbonate fiber, and FXL BULK FIBER (product name, manufactured by ITM Co., Ltd.) as alumina-silica fiber are commercially available, respectively.

[0035] The fibrous inorganic compound contained in the resin composition of the present disclosure particularly preferably includes at least one selected from the group consisting of a potassium titanate fiber and an aluminum borate fiber. Namely, the resin composition of the present disclosure preferably contains, as the ceramic fiber, at least one selected from the group consisting of a potassium titanate fiber and an aluminum borate fiber.

When the fibrous inorganic compound includes at least one selected from the group consisting of a potassium titanate fiber and an aluminum borate, the above-described effects, particularly, the effect of reducing the occurrence of chipping by the enhancement of the internal strength, may become excellent. In addition, since both of the potassium titanate fiber and the aluminum borate fiber is chemically and thermally stable, the effect may be stably exerted at the time of producing and storing the resin composition and at the time of cleaning using the resin composition. Moreover, both of the potassium titanate fiber and the aluminum borate fiber can be sufficiently entangled with the softwood pulp, the internal strength of the resin composition may be further enhanced thereby, which is favorable.

[0036] The content of the fibrous inorganic compound in the resin composition of the present disclosure is preferably in a range of from 1.0 part by mass to 30.0 parts by mass,

more preferably in a range of from 1.0 part by mass to 10.0 parts by mass, and still more preferably in a range of from 3.0 parts by mass to 6.0 parts by mass per 100 parts by mass of the resin composition. When the range is 1.0 part by mass or more, the fibrous inorganic compound may sufficiently exert the effect of acting on dirt on the internal surface of the molding die at the time of cleaning and enabling the resin composition and the dirt to adhere to each other and the effect of enhancing the internal strength of the resin composition, which is favorable. When the range is 30.0 parts by mass or less, fluidity of the resin composition may become sufficient, and thus it may become possible to fill the resin composition into every hole and corner of the package of the die, which is favorable.

[0037] Softwood Pulp

The resin composition of the present disclosure contains a softwood pulp.

The softwood pulp is a pulp obtained by using, as a raw material, a softwood such as *Pinus densiflora*, *Picea jezoensis*, *Abies sachalinensis*, Douglas fir, *Abies firma*, *Larix kaempferi*, pine, *Tsuga heterophylla*, or *Picea sitchensis*.

The softwood pulp has characteristics in which fibers are thick and long and strength is high. On the other hand, a hardwood pulp has characteristics in which fibers are short and thin and the surface is smooth. When a resin composition for cleaning a die has a formulation which includes a pulp, in a case in which the pulp is a softwood pulp, fluidity of the resin composition may tend to be small. The hardwood pulp is widely used in a conventional resin composition for cleaning a die in order to enhance fluidity.

The resin composition of the present disclosure contains a large amount of 1.6 parts by mass of a metal soap, that affects the weakening of the internal strength, per 100 parts by mass of the resin composition, whereas the internal strength of the resin composition of the present disclosure is not decreased, and thus occurrence of chipping of the resin composition in the step of removing the resin composition from the molding die after cleaning can be reduced. It is assumed because the resin composition of the present disclosure has a formulation which includes both of the softwood pulp and the fibrous inorganic compound, and thus the internal strength can be enhanced by entanglement between the softwood pulp and the fibrous inorganic compound. Further, since the resin composition of the present disclosure contains a large amount of the metal soap, the resin composition can possess sufficient fluidity which enables exhibiting excellent cleaning performance.

The softwood pulp may be commercially available, and examples thereof include NSPP1 (product name, manufactured by Nippon Paper Industries Co., Ltd.).

[0038] The resin composition of the present disclosure may contain, in addition to the softwood pulp, another fibrous organic compound such as hardwood pulp, straw pulp,

bamboo pulp, or cotton pulp, as long as the excellent effects of the present disclosure are not impaired.

[0039] In the resin composition of the present disclosure, it is preferable that the softwood pulp is used as a pulp that is impregnated with the melamine-based resin since dispersibility of the softwood pulp in the resin composition may be enhanced and fluctuation in die cleaning performance and fluctuation in internal strength may be reduced. Here, "the pulp is impregnated with the melamine-based resin" means that the resin composition has at least one attribute selected from the group consisting of: at least a part of the amount of the melamine-based resin penetrates into spaces between fibers of the softwood pulp; and at least a part of the amount of the melamine-based resin coats a part of a surface or an entire surface of fibers of the softwood pulp.

In a case in which the pulp is subject to impregnation treatment with the melamine-based resin, the melamine-based resin is preferably in a state of an aqueous solution. For example, the melamine-based resin-impregnated pulp (in other words, pulp-containing, melamine-based resin) may be obtained by impregnating a pulp with a melamine-based resin aqueous solution and then drying the resultant.

[0040] The size of the softwood pulp is not particularly limited, and is preferably in a range of, in terms a fiber length, from 5 μm to 1000 μm and more preferably in a range of from 10 μm to 200 μm from the viewpoint of further enhancing the internal strength of the resin composition. The fiber length of the pulp can be measured by a method according to, for example, JIS P8226-2, which corresponds to ISO16065-2.

The content of the softwood pulp is not particularly limited, and is preferably from 2 parts by mass to 50 parts by mass and more preferably from 2 parts by mass to 10 parts by mass per 100 parts by mass of the resin composition from the viewpoint of enhancing the fluidity of the resin composition in the die cleaning step.

The softwood pulp and the fibrous inorganic compound contained in the resin composition of the present disclosure also exhibit cleaning performance by a so-called polishing effect that physically acts on dirt on the internal surface of the molding die in the die cleaning step, in addition to the effect of enhancing the internal strength of the resin composition. In particular, since the softwood pulp and the fibrous inorganic compound are properly entangled with each other, the resin composition of the present disclosure is excellent in the above-described polishing effect as compared with a conventional resin composition.

[0041] Other components

The resin composition of the present disclosure may contain a component(s) other than necessary components described above as long as the excellent effects of the present

disclosure are not impaired.

Specifically, the resin composition of the present disclosure may further contain, if necessary, resins such as an alkyd resin, a polyester resin, an acrylic resin, and an epoxy resin and/or a rubber. In addition, for example, various additives represented by a lubricant other than a metal soap, a colorant, and an antioxidant agent may be contained.

[0042] The resin composition of the present disclosure may contain a curing catalyst. The curing catalyst is preferably at least one organic acid selected from the group consisting of phthalic anhydride, myristic acid, stearic acid, sulfamic acid, oxalic acid, benzoic acid, trimellitic acid, and p-toluenesulfonic acid, from the viewpoint of reactivity with the melamine-based resin.

[0043] The resin composition of the present disclosure may contain an inorganic filler other than the fibrous inorganic compound from the viewpoint of improving die cleaning performance by the polishing effect.

Examples of the inorganic filler include silicon carbide, silicon oxide (silica), titanium carbide, titanium oxide, boron carbide, boron oxide, aluminum oxide, magnesium oxide, calcium oxide, and calcium carbonate. Particularly, silicon oxide is preferable from the viewpoint of excellent polishing effect.

The compositions of these inorganic fillers may be the same as the composition of the fibrous inorganic compound.

[0044] [Method of Preparing Resin Composition]

The resin composition of the present disclosure is prepared by, for example, nearly homogeneously mixing the melamine-based resin, the metal soap, the fibrous inorganic compound, the softwood pulp, and other additives that are used if necessary with a kneader, a ribbon blender, a Henschel Mixer, a ball mill, a roll kneader, a mortar and pestle machine, a tumbler, or the like.

[0045] Method of Using Resin Composition

The resin composition for cleaning a die of the present disclosure is suitably used for a transfer type resin composition for cleaning a die that is used in a transfer type molding machine.

The resin composition of the present disclosure is usually formed into a tablet shape and used for the cleaning operation on an internal surface of a molding die (inside the molding die). Specifically, in a cleaning operation, a lead frame is disposed on a molding die and then the tablet-shaped resin composition is inserted into a pot portion of the molding die. After mold clamping, the resin composition is extruded by a plunger. At this time, the resin composition flows from the pot portion into the inside of a die cavity through a

runner portion and a gate portion of the molding die. After a predetermined molding time elapses, the die is opened and a molded resultant integrated with the lead frame, that is, a molded resultant of the resin composition containing dirt is removed from the die. The cleaning operation is thus completed.

The resin composition of the present disclosure may be suitably used in removal of dirt generated on the internal surface of the molding die in a sealing and molding operation for an integrated circuit or the like. The material of the molding die is, for example, iron or chromium.

[0046] The resin composition of the present disclosure may be suitably used in removal of dirt, which is derived from a sealing molding material containing a thermosetting resin composition represented by an epoxy resin, a silicone resin, a phenolic resin, and a polyimide resin, from the internal surface of the molding die.

In particular, the resin composition of the present disclosure exerts excellent cleaning performance in cleaning of the inside of the molding die after performing molding by using a sealing molding material called a "green compound", that does not contain components having a large environmental load such as lead, antimony, and halogen compounds.

[0047] A sealing molding material called a green compound, that contains a metal hydroxide-based flame retardant or an organic phosphorus-based flame retardant, and a sealing molding material capable of attaining flame retardation with designing or blending of an epoxy resin have higher adhesiveness to a die than a conventional sealing molding material. For this reason, it is difficult to clean the molding die after performing molding using such a sealing molding material.

The resin composition of the present disclosure is excellent in cleaning performance and workability since a content of the metal soap therein is 1.6 parts by mass or more per 100 parts by mass thereof,. Therefore, the resin composition of the present disclosure is suitably used in application of cleaning the inside of the molding die after sealing and molding a sealing molding material that is called a green compound.

[0048]

EXAMPLES

Hereinafter, the present disclosure will be described in more detail by Examples. However, the present disclosure is not limited to Examples described below as long as the gist of the present disclosure is not exceeded.

[0049] [Preparation of Melamine-Based Resin Containing Softwood Pulp and Melamine-Formaldehyde Resin]

(Production Example 1)

A melamine-formaldehyde resin was formed according to a known method by reacting 480 parts by mass of melamine and 522 parts by mass of formaldehyde (aqueous solution containing 37% by mass of formaldehyde) with each other by heating. 248 parts by mass of softwood pulp (product name: NSPP1, manufactured by Nippon Paper Industries Co., Ltd.) was added to the solution of the thus-obtained resin, and the resultant mixture was kneaded. Then, the kneaded product was dried under reduced pressure and was subjected to powderization, thereby obtaining a softwood pulp-containing melamine-formaldehyde resin.

[0050] (Production Example 2)

A melamine-phenol co-condensate resin was formed according to a known method by reacting 346 parts by mass of melamine, 522 parts by mass of formaldehyde (aqueous solution containing 37% by mass of formaldehyde), and 131 parts by mass of phenol with one another by heating. 248 parts by mass of softwood pulp (product name: NSPP1, manufactured by Nippon Paper Industries Co., Ltd.) was added to the solution of the thus-obtained resin, and the resultant mixture was kneaded. Then, the kneaded product was dried under reduced pressure and was subjected to powderization, thereby obtaining a softwood pulp-containing melamine-phenol co-condensate resin.

[0051] (Production Example 3)

A melamine-formaldehyde resin was formed according to a known method by reacting 480 parts by mass of melamine and 522 parts by mass of formaldehyde (aqueous solution containing 37% by mass of formaldehyde) by heating. 248 parts by mass of hardwood pulp (product name: LDPT, manufactured by Nippon Paper Industries Co., Ltd.) was added to the solution of the thus-obtained resin, and the resultant mixture was kneaded. Then, the kneaded product was dried under reduced pressure and was subjected to powderization, thereby obtaining a hardwood pulp-containing melamine-formaldehyde resin.

[0052] [Preparation of Resin Composition for Cleaning Die]

(Example 1)

30 parts by mass of softwood pulp-containing melamine-formaldehyde resin of Production Example 1 (including 22 parts by mass of melamine-formaldehyde resin and 8 parts by mass of softwood pulp), 50 parts by mass of melamine-based resin (product name: NIKARESIN S-166, manufactured by Nippon Carbide Industries Co., Inc.), 20 parts by mass of silica (product name: PURE SILICA POWDER, manufactured by Seto Ceramic Raw Materials Co., Ltd.), 5.0 parts by mass of potassium titanate fiber (product name: TISMO D, manufactured by Otsuka Chemical Co., Ltd.), and 1.8 parts by mass of zinc myristate were charged into a ball mill and pulverized. Then, 0.4 parts by mass of ethylene bis stearamide

was added thereto and mixed with a nauta mixer, thereby obtaining a resin composition of Example 1. The resin composition thus obtained was molded into a tablet shape and used for die cleaning evaluation.

The amount of the metal soap with respect to 100 parts by mass of the resin composition is 1.7 parts by mass.

[0053] (Example 2)

A resin composition was obtained in the same manner as in Example 1, except that 2.0 parts by mass of zinc myristate was used as the metal soap and the amount of the metal soap was 1.9 parts by mass per 100 parts by mass of the resin composition as shown in the formulation described in Table 1.

[0054] (Example 3)

A resin composition was obtained in the same manner as in Example 1, except that 5.0 parts by mass of zinc myristate was used as the metal soap and the amount of the metal soap was 4.5 parts by mass per 100 parts by mass of the resin composition as shown in the formulation described in Table 1.

[0055] (Example 4)

A resin composition was obtained in the same manner as in Example 1, except that 2.0 parts by mass of zinc laurate was used as the metal soap and the amount of the metal soap was 1.9 parts by mass per 100 parts by mass of the resin composition as shown in the formulation described in Table 1.

[0056] (Example 5)

A resin composition was obtained in the same manner as in Example 1, except that 2.0 parts by mass of zinc stearate was used as the metal soap as shown in the formulation described in Table 1.

[0057] (Example 6)

A resin composition was obtained in the same manner as in Example 1, except that an aluminum borate fiber (product name: ALBOREX Y, manufactured by Shikoku Chemicals Corporation) was used as the fibrous inorganic compound, 2.0 parts by mass of zinc myristate was used as the metal soap, and 0.1 part by mass of benzoic acid serving as a curing catalyst was used as shown in the formulation described in Table 1.

[0058] (Example 7)

A resin composition was obtained in the same manner as in Example 1, except that 30 parts by mass of the softwood pulp-containing melamine-phenol co-condensate of Production Example 2 was used instead of the softwood pulp-containing melamine-formaldehyde resin of Production Example 1, an aluminum borate fiber (product

name: ALBOREX Y, manufactured by Shikoku Chemicals Corporation) was used as the fibrous inorganic compound, and 2.0 parts by mass of zinc myristate was used as the metal soap as shown in the formulation described in Table 1.

[0059] (Example 8)

A resin composition was obtained in the same manner as in Example 1, except that an aluminum borate fiber (ALBOREX Y, manufactured by Shikoku Chemicals Corporation) was used as the fibrous inorganic compound and 2.0 parts by mass of zinc myristate was used as the metal soap as shown in the formulation described in Table 1.

[0060] (Comparative Example 1)

A resin composition was obtained in the same manner as in Example 1, except that 1.6 parts by mass of zinc myristate was used as the metal soap and the amount of the metal soap was set to be 1.5 parts by mass per 100 parts by mass of the resin composition as shown in the formulation described in Table 1.

[0061] (Comparative Example 2)

A resin composition was obtained in the same manner as in Example 1, except that 5.7 parts by mass of zinc myristate was used as the metal soap and the amount of the metal soap was 5.1 parts by mass per 100 parts by mass of the resin composition as shown in the formulation described in Table 1.

[0062] (Comparative Example 3)

A resin composition was obtained in the same manner as in Example 7, except that the hardwood pulp-containing melamine-formaldehyde resin of Production Example 3 was used instead of the softwood pulp-containing melamine-formaldehyde resin of Production Example 1 as shown in the formulation described in Table 1.

[0063] (Comparative Example 4)

A resin composition was obtained in the same manner as in Example 2, except that the fibrous inorganic compound was not used as shown in the formulation described in Table 1.

[0064] Table 1

Unit: part by mass

		Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7	Example 8	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4
		30	30	30	30	30	30	-	30	30	30	-	30
Composition	Production Example 1 Softwood pulp-containing melamine-formaldehyde resin	-	-	-	-	-	-	30	-	-	-	-	-
	Production Example 2 Softwood pulp-containing melamine-phenol co-condensate	-	-	-	-	-	-	-	-	-	-	-	-
	Production Example 3 Hardwood pulp-containing melamine-formaldehyde resin	-	-	-	-	-	-	-	-	-	-	30	-
	Melamine-based resin NIKARESIN S-166	50	50	50	50	50	50	50	50	50	50	50	50
	Metal soap	1.8	2.0	5.0	-	-	2.0	2.0	2.0	1.6	5.7	2.0	2.0
	Zinc myristate	-	-	-	2.0	-	-	-	-	-	-	-	-
	Zinc laurate	-	-	-	-	2.0	-	-	-	-	-	-	-
	Zinc stearate	-	-	-	-	-	-	-	-	-	-	-	-
	Potassium titanate fiber	5	5	5	5	5	-	-	-	5	5	-	-
	TISMO D	-	-	-	-	-	-	-	-	-	-	-	-
	Aluminum borate fiber	-	-	-	-	-	5	5	5	-	-	5	-
	ALBOREX Y	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
	Ethylene bis-stearic acid amide	20	20	20	20	20	20	20	20	20	20	20	20
Evaluation	Silica PURE SILICA POWDER	-	-	-	-	-	0.1	-	-	-	-	-	-
	Curing agent	1.7	1.9	4.5	1.9	1.9	1.9	1.9	1.9	1.5	5.1	1.9	2.0
	Benzoic acid	3	2	3	2	2	3	3	2	4	3	2	3
	Content of metal soap per 100 parts by mass of resin composition for cleaning die	3	2	3	2	2	3	3	2	4	3	2	3
Evaluation	Cleaning performance (number of shots)	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Present	Present
	Workability (presence or absence of chipping)	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present	Present	Present

[0065] [Evaluation]

Die cleaning performance and die releasing property of each resin composition of Examples and Comparative Examples were evaluated by the following methods.

The formulations and evaluations of the resin compositions of Examples and Comparative Examples were collectively described in Table 1.

500 shots of quad flat packages (QFP) were formed by molding an epoxy resin molding material (product name: CEL-9240HF10, manufactured by Hitachi Chemical Company, Ltd.), that is what is called a green compound, and a QFP molding die equipped with a gate portion (width: 800 μm , height: 300 μm) with an automatic transfer molding machine (die temperature: 175°C, transfer pressure: 8.7 MPa, transfer time: 6.5 seconds, curing time: 80 seconds), and then dirt was caused to be generated on the internal surface of the molding die.

The resin composition of each of Examples or Comparative Examples was repeatedly molded under the same conditions as the molding conditions of the epoxy resin molding material, except that the molding die having dirt on the internal surface thereof was used and the curing time was set to 180 seconds, and thus die cleaning was performed. At this time, the number of shots required until dirt on the internal surface of the molding die was completely removed was counted. This number of shots was regarded as an index for evaluating the die cleaning performance of the resin composition. Whether or not dirt can be completely removed from the molding die was determined by visual inspection.

In the evaluation of cleaning performance, the focus was particularly put on whether or not dirt adhering to the gate portion or the corner portion in the cavity of the molding die can be completely removed. The smaller number of shots indicates the better die cleaning performance of the resin composition. The resin composition in which the number of shots is in a range of from 1 to 3 was evaluated as satisfactory.

Along with the evaluation of die cleaning performance in the cleaning step, workability was evaluated by determining whether or not chipping of the resin composition occurred by visual inspection after a first shot molding. That is, in the step of removing the resin composition from the molding die after the first shot molding, a case in which no chipping of the resin composition is found and workability of die cleaning is favorable was considered as "Absent" and a case in which there is chipping and thus there is difficulty in workability was considered as "Present."

[0066] The die cleaning performance of the resin composition of each of Examples and Comparative Examples was evaluated by the evaluation method described above. In the resin composition of each of Examples 1 to 8 and Comparative Examples 2 to 4, the shot

number required until cleaning is completed was three times or less. That is, all of the resin compositions of Examples and the resin compositions of Comparative Examples 2 to 4 exhibited excellent cleaning performance.

On the other hand, the shot number in the resin composition of Comparative Example 1 was four times and was more than those in all Examples.

As understood from the results shown above, the resin composition of the present disclosure has sufficient fluidity to exhibit the excellent cleaning performance since it includes a melamine-based resin, a metal soap, a fibrous inorganic compound, and a softwood pulp, and has a content of the metal soap of from 1.6 parts by mass to 5.0 parts by mass per 100 parts by mass of the resin composition.

[0067] The presence or absence of chipping of the resin composition of each of Examples and Comparative Examples was evaluated by the evaluation method described above. In the die cleaning step using all of the resin compositions of Examples and the resin composition of Comparative Example 1, there was no chipping in the resin composition after molding and workability was favorable. On the other hand, in the die cleaning step using the resin composition of each of Comparative Examples 2 to 4, chipping occurred and workability was low.

In other words, in the die cleaning after molding a green compound, all of the resin compositions of Examples were excellent in workability in the step of removing the resin composition from the molding die after cleaning and cleaning performance. In contrast, the resin compositions of Comparative Examples were inferior in at least one of workability in the step of removing the resin composition from the molding die after cleaning or cleaning performance.

As understood from the results shown above, the resin composition of the present disclosure has the excellent workability in the step of removing the resin composition from the molding die after cleaning even though a content of the metal soap thereof is relatively large as much as of from 1.6 parts by mass to 5.0 parts by mass per 100 parts by mass thereof, since it includes a melamine-based resin and a metal soap and further includes a fibrous inorganic compound and a softwood pulp.

[0068] Workability at cleaning when the resin compositions of Examples 2 and 3 and Comparative Example 2 are respectively evaluated in more detail.

Chipping occurs due to insufficient internal strength of a molded resultant that is a cured resultant of a resin composition. The internal strength of a molded resultant can be expressed by way of a flexural strength. There is a strong correlation between the flexural strength and occurrence/absence of chipping.

Measurement of the flexural strengths of the respective molded resultants was performed as described below in accordance with a testing method for thermosetting plastics of JIS K 6911. Specifically, each resin composition for cleaning a molding die was subject to molding under the condition of die temperature of 170°C and molding time of 3 minutes using a transfer molding machine and a die for molding a test piece to provide test pieces having a height (h) of 4mm, a width (w) of 10 mm, and a length of 80 mm. Load was applied to each of the test pieces by using a tension and compression testing machine with setting a distance between supporting points (Lv) to 64 mm and a rate of loading to 2mm/min to measure a load (P) applied at the time when the test piece broke. A bending strength ($\sigma_f B$) was calculated from the equality of $\sigma_f B = 3PL_v/2Wh^2$. It was found that Examples 2 and 3 and Comparative Example 2 had the bending strength of 180MPa, 140MPa, and 105MPa, respectively.

According to the result of the above experiment, the molded resultants made from the resin compositions of Examples 2 and 3, which caused no chipping in the cleaning process, exhibited moderately high bending strength, while the molded resultant made from the resin composition of Comparative Example 2, which generated chipping in the cleaning process, exhibited small bending strength. The molded resultant made from the resin composition of Example 2 exhibited higher bending strength than that of Example 3.

[0069] Hereinbefore, as described in Examples and Comparative Examples, according to the present disclosure, it was possible to provide a resin composition for cleaning a die which is excellent in workability in the removing step of removing the resin composition from the molding die after cleaning and cleaning performance. In particular, even in the case of die cleaning after molding a green compound that is difficult to clean, the resin composition of the present disclosure exhibited excellent performance.

[0070] The resin composition for cleaning a die of the present disclosure is a transfer-type resin composition for cleaning a die which is used for removing dirt that is derived from a thermosetting resin composition and remains on the internal surface of the molding die, and is excellent in workability in the removing step of removing the resin composition from the molding die after cleaning and cleaning performance.

CLAIMS

1. A resin composition for cleaning a die, the resin composition comprising:
a melamine-based resin;
a metal soap;
a fibrous inorganic compound; and
a softwood pulp,
a content of the metal soap being from 1.6 parts by mass to 5.0 parts by mass per 100 parts by mass of the resin composition,
the metal soap comprising a zinc salt of a fatty acid, and
the zinc salt of a fatty acid being at least one selected from the group consisting of zinc myristate, zinc laurate, and zinc stearate.
2. The resin composition for cleaning a die according to claim 1, wherein the fibrous inorganic compound comprises a ceramic fiber.
3. The resin composition for cleaning a die according to claim 2, wherein the ceramic fiber comprises at least one selected from the group consisting of a potassium titanate fiber and an aluminum borate fiber.
4. The resin composition for cleaning a die according to any one of claims 1 to 3, wherein the melamine-based resin includes at least one selected from the group consisting of a melamine-formaldehyde resin and a melamine-phenol co-condensate.
5. The resin composition for cleaning a die according to any one of claims 1 to 4, wherein the softwood pulp is impregnated with the melamine-based resin.
6. The resin composition for cleaning a die according to any one of claims 1 to 5, wherein a content of the softwood pulp is from 2 parts by mass to 10 parts by mass per 100 parts by mass of the resin composition for cleaning a die.
7. The resin composition for cleaning a die according to any one of claims 1 to 6, wherein a content of the fibrous inorganic compound is from 1.0 part by mass to 30.0 parts by mass per 100 parts by mass of the resin composition for cleaning a die.