

RESIN COMPOSITION FOR CLEANING DIE

Technical Field

[0001] The present disclosure 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, of which an epoxy resin, a silicone resin, a phenolic resin, a polyimide resin and the like are representatives, continuing a long-term sealing molding operation of an integrated circuit, an LED element, or the like tends to cause a stain originating from the sealing molding material. Such a stain left in the die causes defects such as adhesion of the stain onto a surface of a sealing-molded product such as an integrated circuit or an LED element. Therefore, it is necessary to remove the stain from an internal surface of the molding die that adhered thereto in a sealing molding. Specifically, it can be performed by 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.

[0003] Such a resin composition for cleaning a die has hitherto been proposed. For example, International Patent Application No. 2002/030648 and International Patent Application No. 2013/111709 respectively describe a resin composition for cleaning a die which contains a melamine-based resin.

[0004] In general, a sealing molding operation of an integrated circuit or an LED element is carried out by controlling the molding die temperature to from 160°C to 200°C. For such a reason, the resin compositions for cleaning a die are designed such that the resin composition for cleaning a die are molded at from 160°C to 200°C and stain adhered on an internal surface of a molding die can be removed.

SUMMARY OF THE INVENTION

[0005] In recent years, for sealing molding of products such as an LED element, a sealing material which is to be molded at a lower molding die temperature than conventional ones, specifically at a temperature of from 125°C to 150°C, has become to be used. When a conventional resin composition for cleaning a die is used in a range of from 125°C to 150°C, it takes very long time for curing of the resin composition for cleaning a die, and as a cured product of the resin composition for cleaning a die may easily remain on an internal surface of a molding die, the internal surface of a molding die may get stain, yielding a cause of having adhesion of stain on a surface of a sealing molded product.

Alteration in a design to lower the melting temperature of a curing agent that is

contained in a resin composition for cleaning a die and to perform the curing at a temperature range of from 125°C to 150°C may be considered to solve the above problem. However, the inventors of the present disclosure found that, when a resin composition for cleaning a die containing a curing agent having a low melting temperature is used for cleaning, excessive curing or insufficient curing (that is, excessive flow) occurs, and thus curing of the resin composition for cleaning a die cannot be sufficiently controlled, and stain on an internal surface of a molding die cannot be removed. That is because, at the time of cleaning an internal surface of a molding die, the temperature window from room temperature to the temperature allowing molding of the resin composition for cleaning a die is narrow, and thus as the temperature increases rapidly, curing of the resin composition for cleaning a die occurs rapidly. Accordingly, curing of the resin composition for cleaning a die cannot be uniformly achieved, and excessive curing or excessive flow occurs.

[0006] The disclosure is devised in consideration of the above circumstances. The object of the present disclosure is to provide a resin composition for cleaning a die which exhibits improved cleaning performance by suppressing excessive curing and excessive flow during cleaning of an internal surface of a molding die at the molding die temperature which is in a range of from 125°C to 150°C.

[0007] The present invention encompasses the following embodiments.

[1] A resin composition for cleaning a die, the resin composition comprising;
a melamine-based resin;
a first curing catalyst having a melting temperature of from 43°C to 115°C; and
a second curing catalyst having a melting temperature that is from 53°C to 125°C and that is higher by 10°C or more, than the melting temperature of the first curing catalyst.

[0008] [2] The resin composition for cleaning a die according to [1], wherein a total content of the first curing catalyst and the second curing catalyst is in a range of from 0.02 part by mass to 9 parts by mass with respect to 100 parts by mass of the resin composition.

[0009] [3] The resin composition for cleaning a die according to [1] or [2], wherein a ratio of a content of the second curing catalyst with respect to a content of the first curing catalyst is in a range of from 400/1 to 1/400, on a mass basis.

[0010] [4] The resin composition for cleaning a die according to any one of [1] to [3], wherein the first curing catalyst comprises at least one selected from the group consisting of stearic acid and behenic acid, and the second curing catalyst comprises at least one selected from the group consisting of benzoic acid and o-toluic acid.

[0011] [5] The resin composition for cleaning a die according to any one of [1] to [4], wherein the resin composition is used to clean a die provided on a transfer-type molding

machine.

Advantageous Effect of Invention

[0012] According to the present disclosure, a resin composition for cleaning a die which exhibits improved cleaning performance by suppressing excessive curing and excessive flow during cleaning of an internal surface of a molding die at the molding die temperature which is in a range of from 125°C to 150°C may be provided.

DESCRIPTION OF EMBODIMENTS

[0013] 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.

[0014] A numerical value range indicated by using "from ... to ..." as used herein refers to a range including numerical values described before and after "to" as the minimum and maximum values, respectively. Further, when plural substances corresponding to each component are present in a composition, an amount of each component in the composition means a total amount of the plural substances present in the composition unless otherwise specified.

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. A molding die may be simply referred to as a "die" in some cases.

[0015] The resin composition for cleaning a die of the present disclosure enables removal of stain on an internal surface of a molding die which occur during a process of molding a sealing molding material (that is, a curable resin composition) which is curable at from 125°C to 150°C and which is, for example, selected from the group consisting of an epoxy resin, a silicone resin, a phenol resin, and a polyimide resin.

[0016] The resin composition for cleaning a die of the present disclosure contains a melamine-based resin, a first curing catalyst, and a second curing catalyst, a melting temperature of the first curing catalyst and a melting temperature of the second curing catalyst being different from each other.

A melting temperature of the first curing catalyst is lower than the melting temperature of the second curing catalyst.

A process for cleaning an internal surface of a molding die using the resin

composition of the present disclosure is as follows. First, after disposing a lead frame on a molding die at room temperature, the resin composition molded in tablet shape is inserted to a pot portion and the die is clamped. When a temperature of the molding die increases, the melamine-based resin and the first curing catalyst start to react first to yield suitable curing of the resin composition. At this time, the flow (that is, fluidity) is also controlled. Further, as the temperature of a molding die increases, the resin composition and the second curing catalyst start to react. Subsequently, the resin composition is extruded by a plunger. At this time, the resin composition in the pot portion passes through a runner portion and a gate portion, and flows into an inside of a cavity (that is, internal surface of a molding die). After that, the melamine-based resin and the second curing catalyst further react to yield curing of the resin composition. Since the resin composition of the present disclosure contains the first curing catalyst and the second curing catalyst which has a melting temperature that is higher by 10°C or more than that of the first curing catalyst, the resin composition of the present disclosure can have a balance between the curing and the flow of the resin composition even at difficult molding conditions like a range of from 125°C to 150°C, and thus molding of the resin composition can be favorably performed and the mold release property may become sufficient, thus exhibiting an excellent die cleaning performance.

Incidentally, when a resin composition in which only the first curing catalyst with a low melting temperature is used for cleaning of an internal surface of a molding die in a range in which a molding die temperature is from 125°C to 150°C, die cleaning performance may become insufficient since such a resin composition may not be sufficiently cured on the internal surface of a molding die. When a resin composition in which only the second curing catalyst with a high melting temperature is used for cleaning of an internal surface of a molding die in a range in which a molding die temperature is from 125°C to 150°C, die cleaning performance may become insufficient since such a resin composition may have excessive flow at the time of being extruded by a plunger so that the resin composition may not be uniformly spread all over an internal surface of the molding die. Accordingly, cleaning performance of such the resin compositions may be insufficient.

[0017] [Melamine-based resin]

The resin composition for cleaning a die of the present disclosure includes a 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.

[0018] The melamine resin is a condensate of a triazine compound and an aldehyde compound. Examples of the triazine compound include melamine, benzoguanamine, and

acetoguanamine. Examples of the aldehyde compound include formaldehyde, paraformaldehyde, and acetaldehyde.

A molar ratio of a repeating unit derived from the triazine compound to a repeating unit derived from the aldehyde compound in the melamine resin (triazine : aldehyde) is preferably from 1:1.2 to 1:4.

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

[0019] The melamine-phenol co-condensate resin is a co-condensate of a triazine compound, a phenol compound, and an aldehyde compound. Examples of the phenol compound include phenol, cresol, xylenol, ethylphenol, and butylphenol.

[0020] The melamine-urea co-condensate resin is a co-condensate of a triazine compound, a urea compound, and an aldehyde compound.

Examples of the urea compound include urea, thiourea, and ethylene urea.

An amount of the triazine compound with respect to the total amount of the triazine compound and the phenol compound in a raw material for forming the melamine-phenol co-condensate resin and an amount of the triazine compound with respect to the total amount of the triazine compound and the urea compound 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.

[0021] 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.

[0022] The resin composition for cleaning a die of the present disclosure exhibits excellent cleaning performance for removing a stain on an internal surface of a molding die because of including the melamine-based resin. Although the reason thereof is not completely clear, the inventors consider 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 stain that is generated in molding, adheres to an internal surface of a molding die, and originates from a sealing molding material.

[0023] [Curing Catalyst]

The resin composition for cleaning a die of the present disclosure contains at least: a first curing catalyst having a melting temperature of from 43°C to 115°C; and a second curing

catalyst having a melting temperature which is from 53°C to 125°C and which is higher by 10°C or more, than the melting temperature of the first curing catalyst.

Since the melting temperature of the first curing catalyst is 43°C or higher, the resin composition of the present disclosure shows substantially no progress of curing at the time of preparation of the resin composition and also substantially no deterioration during storage of a resin composition.

Further, since the melting temperature of the second curing catalyst is 125°C or lower, the resin composition of the present disclosure can be sufficiently cured at the time of being subject to cleaning of an internal surface of a molding die and can have a uniform state at the time of pressurizing a molding die, and thus stain on an internal surface of a molding die can be suitably removed.

Further, since the melting temperature of the second curing catalyst is higher by 10°C or more than the melting temperature of the first curing catalyst, the resin composition of the present disclosure can, after molding of a sealing molding material that is cured at from 125°C to 150°C, suitably achieve both of curing of the resin composition before being extruded by a plunger according to an action of the first curing catalyst and curing of the resin composition in the inside of a cavity (that is, internal surface of a molding die) according to an action of the second curing catalyst, without causing an excessive flow.

Incidentally, it is more preferable that the melting temperature of the second curing catalyst is higher by 15°C than the melting temperature of the first curing catalyst, and the melting temperature of the second curing catalyst is more preferably higher by 25°C or more than the melting temperature of the first curing catalyst.

[0024] In the present specification, the melting temperature of each of the first curing catalyst and the second curing catalyst is obtained based on JIS K0064: "Test methods for measuring melting point and melting range of chemical products".

[0025] In the resin composition of the present disclosure, a total content of the first curing catalyst and the second curing catalyst with respect to 100 parts by mass of the resin composition is preferably from 0.02 part by mass to 9 parts by mass, more preferably from 0.05 part by mass to 5 parts by mass, and even more preferably from 0.1 part by mass to 3 parts by mass. As the total content of the first curing catalyst and the second curing catalyst is 0.02 part by mass or more, the resin composition of the present disclosure can be cured without having excessive time at each step of before extrusion with a plunger and being inside of a cavity. This makes the working property during a process of cleaning an internal surface of a molding die be favorable, and is therefore desirable. Further, as the total content of the first curing catalyst and the second curing catalyst is 9 parts by mass or less, excessive

curing can be suppressed at each step of before extrusion with a plunger and being inside of a cavity, and is therefore desirable.

[0026] Examples of the first curing catalyst which can be preferably used in the present disclosure include lauric acid, 3-phenyl propionic acid, maleic anhydride, myristic acid, palmitic acid, stearic acid, behenic acid, p-methoxy phenylacetic acid, o-tolylacetic acid, p-tolylacetic acid, montanic acid, citric acid monohydrate, m-toluic acid, o-toluic acid, succinic anhydride, benzoic acid, and naphthalene sulfonic acid hydrate.

Examples of the second curing catalyst which can be preferably used in the present disclosure include maleic anhydride, myristic acid, palmitic acid, stearic acid, behenic acid, p-methoxy phenylacetic acid, o-tolylacetic acid, p-tolylacetic acid, montanic acid, citric acid monohydrate, m-toluic acid, o-toluic acid, succinic anhydride, benzoic acid, naphthalene sulfonic acid hydrate, benzilic acid, and terephthalic acid.

[0027] A curing catalyst of which melting temperature is from 53°C to 115°C can be preferably used as the first curing catalyst and also as the second curing catalyst in the resin composition of the present disclosure. For example, in a case in which stearic acid, of which melting temperature is 70°C, is used in combination with benzoic acid, of which melting temperature is higher by 10°C or more than that of stearic acid, stearic acid functions as the first curing catalyst. In a case in which stearic acid is used in combination with myristic acid, of which melting temperature is lower by 10°C or more than that of stearic acid, stearic acid functions as the second curing catalyst. The resin composition of the present disclosure exhibits the aforementioned excellent working effect by using a combination of the first curing catalyst and the second curing catalyst, of which melting temperature is higher by 10°C or more than that of the melting temperature of the first curing catalyst.

[0028] The resin composition of the present disclosure may contain, for example, two or more kinds of the first curing catalyst and/or two or more kinds of the second curing catalyst within a range in which the effect of the present disclosure is not inhibited,. For example, the resin composition of the present disclosure may contain behenic acid, of which melting temperature is 76°C, citric acid monohydrate, of which melting temperature is 100°C, and benzoic acid, of which melting temperature is 124°C. In the resin composition of this combination, citric acid monohydrate functions not only as the first curing catalyst but also as the second curing catalyst.

Incidentally, when each of the first curing catalyst and the second curing catalyst contained in the resin composition of the present disclosure is only one kind, curing can be achieved more appropriately at each step of before extrusion with a plunger and being inside of a cavity, and therefore preferable.

[0029] When each of the first curing catalyst and the second curing catalyst contained in the resin composition of the present disclosure is only one kind, a ratio of a content of the second curing catalyst (on mass basis) with respect to a content of the first curing catalyst is preferably from 400/1 to 1/400, more preferably from 10/1 to 1/10, and even more preferably from 3/1 to 1/3. As the content ratio is from 400/1 to 1/400, excessive flow can be further suppressed and more appropriate curing can be achieved at each step of before extrusion with a plunger and being inside of a cavity.

For example, when the resin composition for cleaning a die containing 0.3 part by mass of stearic acid, of which melting temperature is 70°C as the first curing catalyst, and 0.1 part by mass of benzoic acid, of which melting temperature is 122°C as the second curing catalyst, the ratio of the content of the second curing catalyst with respect to the content of the first curing catalyst in the resin composition is 1/3.

In a case in which the resin composition of the present disclosure contains two or more kinds of any one of the first curing catalyst and the second curing catalyst, the ratio of the content of the second curing catalyst with respect to the content of the first curing catalyst is not defined.

[0030] The resin composition of the present disclosure in which the first curing catalyst includes at least one or more selected from the group consisting of stearic acid and behenic acid and the second curing catalyst includes at least one or more selected from the group consisting of benzoic acid and o-toluic acid is preferable in that excessive curing and excessive flow can be further suppressed.

[0031] Within a range in which the excellent effect of the present disclosure is not inhibited, the resin composition of the present disclosure may further contain a curing catalyst other than the first curing catalyst and the second curing catalyst.

[0032] [Additives]

The resin composition for cleaning a die of the present disclosure may further contain an additive that is other than the components described above. Examples of such an additive include an organic filler, an inorganic filler, a metal salt of a saturated fatty acid, a metal salt of an unsaturated fatty acid, a lubricant, a wax component, a coloring agent, and an anti-oxidant.

[0033] To maintain suitable strength of the resin composition of the present disclosure, the resin composition preferably contains an organic filler as an additive.

Examples of the organic filler include pulp, wood powder, and synthetic fiber. Among them, pulp is particularly preferable.

Examples of the pulp include wood pulp such as softwood pulp or hardwood pulp

and non-wood pulp such as straw, bamboo, bagasse, or cotton.

The resin composition of the present disclosure may contain any one of chemical pulp and mechanical pulp.

[0034] In view of maintaining suitable strength of the resin composition and improved cleaning performance due to physical polishing effect to a surface of a molding die, the resin composition of the present disclosure may preferably contain an inorganic filler.

Examples of the inorganic filler include, in addition to silicon carbide, silicon oxide (silica), titan carbide, titan oxide, boron carbide, boron oxide, aluminum oxide, magnesium oxide, calcium oxide, and calcium carbonate, fibrous inorganic compounds like glass fiber, metal fiber, and ceramic fiber.

In particular, due to an excellent performance for removing stain based on the polishing effect during the process of cleaning an internal surface of a molding die, the resin composition of the present disclosure may preferably contain silicon oxide (silica).

[0035] Examples of the metal salt of a saturated fatty acid or an unsaturated fatty acid include a metal salt of a saturated fatty acid or an unsaturated fatty acid in which the metal nucleus is Ca, Zn, Al, Ba, Mg, Li, Mn, Na, or K.

[0036] Examples of the lubricant include a fatty acid amide-based lubricant, specifically, a saturated or unsaturated monoamide type lubricant represented by lauric acid amide, myristic acid amide, erucic acid amide, oleic acid amide, and stearic acid amide, and a saturated or unsaturated bisamide type lubricant represented by methylene bisstearic acid amide, ethylene bisstearic acid amide, and ethylene bisoleic acid amide.

[0037] Examples of the wax component include synthetic wax represented by polyethylene wax and polypropylene wax, mineral wax represented by montanic acid wax, plant wax represented by carnauba wax and palm wax, animal wax represented by bee wax, and petroleum wax represented by paraffin wax.

[0038] The resin composition of the present disclosure may be suitably used in removal of stain, 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 an internal surface of a molding die.

[0039] The resin composition for cleaning a die of the present disclosure is a transfer-type resin composition, which is to be used for cleaning a die provided on a transfer-type molding machine (transfer-type press machine).

[0040] The resin composition of the present disclosure may be prepared by mixing the melamine-based resin, the first curing catalyst, and the second curing catalyst, and other additives if necessary. A method of the mixing is not particularly limited, and examples

thereof include a mixing method using a known mixer such as a kneader, a ribbon blender, a Henschel Mixer, a ball mill, a roll kneader, a grinding machine, a tumbler, or the like.

[0041] 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. 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 resultant integrated with the lead frame, that is a resultant molded from the resin composition containing stain, is removed from the die. The cleaning operation is thus completed.

[0042] The resin composition for cleaning a die of the present disclosure is preferably used for removing stain that is present on an internal surface of a molding die during a sealing molding process of an integrated circuit, an LED element and the like. Material of a molding die is iron or chrome, for example. The internal surface of a molding die generally has been subject to a plating treatment.

Repetition of each process of a cleaning, after carrying out several hundred shots of a sealing molding process by using the aforementioned sealing molding material, an internal surface of a molding die by using the resin composition of the present disclosure, and carrying out subsequently several hundred shots of the sealing molding process enables stable production of a sealed and molded product like an integrated circuit and an LED element.

EXAMPLES

[0043] Hereinbelow, the disclosure is described in further detail by using Examples and Comparative Examples. However, the disclosure is not limited to those Examples.

[0044] [Preparation of Pulp-Incorporated Melamine-Formaldehyde Resin Powder]
(Preparation Example 1)

346 parts by mass of melamine and 522 parts by mass of formaldehyde (37% by mass aqueous solution) were subjected to a reaction under heating to prepare a melamine-formaldehyde resin by a known method. To the obtained melamine-formaldehyde resin solution, 95 parts by weight of hardwood pulp (LDPT, Nippon Paper Industries Co., Ltd.) was added as an organic filler. After kneading, the resultant was subject to drying under reduced pressure to result in a pulp-incorporated melamine-formaldehyde resin powder with pulp content of 15% by mass.

[0045] [Preparation of Resin Composition for cleaning a die]

(Example 1)

Each of 30 parts by mass the pulp-incorporated melamine-formaldehyde resin powder obtained in the Preparation Example 1 and 50 parts by mass of NIKARESIN S-166 (product name, melamine-formaldehyde resin, Nippon Carbide Industries Co., Inc.) as a melamine-based resin, 0.3 part by mass of stearic acid with melting temperature of 70°C as a first curing catalyst (manufactured by Wako Pure Chemical Industries, Ltd.), 0.1 part by mass of benzoic acid with melting temperature of 122°C as a second curing catalyst (manufactured by Wako Pure Chemical Industries, Ltd.), 20 parts by mass of silicon oxide (product name: JUN-KEISEKIFUN, crystalline silica, Seto Ceramic Raw Materials Co., Ltd.) as an inorganic filler, and 0.4 part by mass of zinc stearate (product name: ZINC STEARATE GF200, manufactured by NOF Corporation) as a metal salt of a saturated fatty acid was added to a ball mill followed by pulverization. Subsequently, 0.4 part by mass of ethylene bisstearic acid amide was added as a lubricant by using a Nauta mixer followed by stirring to obtain a resin composition for cleaning a die of Example 1. The resin composition for cleaning a die thus obtained was processed into a tablet form and used for evaluation of cleaning of an internal surface of a molding die.

[0046] (Examples 2 to 12 and Comparative examples 1 to 4)

Resin compositions for cleaning a die of Examples 2 to 12 and Comparative examples 1 to 4 were respectively prepared in the same manner as Example 1, except that formulations thereof were changed as shown in the formulations described in the following Table 1.

Numerical values of the composition in Table 1 are expressed in parts by mass.

"-" means that the ingredient is not included in the composition.

The temperature described in parenthesis after component name of each curing catalyst indicates melting temperature.

[0047] [Evaluation of Resin Composition for cleaning a die]

For each of the prepared resin composition for cleaning a die, each performance was evaluated based on the test method described below. All of the prepared resin compositions for cleaning a die are a transfer type.

[0048] (Evaluation of Curing Property)

With regard to the curing property of the resin composition for cleaning a die, evaluation was made by using CURELASTOMETER-WP TYPE (product name, manufactured by JSR Corporation; W100 is used as a die) as a tester and by curing the resin composition at molding die temperature condition of 100°C. The time for having 90% of the maximum torque is set as T90, and a case in which T90 is from 50 minutes to 60 minutes is

graded "excellent". A case in which T90 is from 60 minutes to 70 minutes is graded "good". A case in which T90 is from 70 minutes to 80 minutes is graded "acceptable". A case in which T90 is 80 minutes or longer or the resin composition is not cured is graded "not acceptable". Incidentally, curing of a resin composition was determined by visual observation.

[0049] (Evaluation of Fluidity)

Fluidity (flow) is one indicator showing the flowing property of a resin composition for cleaning a die, and it can be determined based on a spiral flow value. When the fluidity of a resin composition is excessively high or excessively low, that is, when the spiral flow is excessively long or excessively short, a problem occurs when the resin composition is forced to flow with an aid of a plunger or pressure is applied during molding on an internal surface of a molding die, and thus the resin composition is not sufficiently supplied to an internal surface of a molding die, yielding a problem in cleaning.

The fluidity of the resin composition of each Example and Comparative example was measured at conditions including molding die temperature of 120°C, clamp pressure of 17.5 Mpa, and transfer pressure of 1.96 Mpa based on the standards of ASTM D-3123.

A case in which the spiral flow length is from 15 inch to 30 inch and the fluidity is very good is graded "excellent". A case in which the spiral flow length is from 10 inch to 15 inch and the fluidity is slightly poor but still good is graded "good". A case in which the spiral flow length is from 5 inch to 10 inch and the fluidity is poor but acceptable is graded "acceptable". A case in which the spiral flow length is less than 5 inch or more than 30 inch is graded "not acceptable".

[0050] (Evaluation of Die Release Property)

The die release property was evaluated in terms of the time required for removing the resin composition without having any adhesion on an internal surface of a molding die when the resin composition is molded (that is, when die cleaning is performed). Shorter time indicates a more excellent die release property.

The die release property of the resin composition of each Example and Comparative example was evaluated by using a transfer type automatic molding machine using a die of 24 mm × 24 mm quad flat package (QFP) of which cavity gate part has a width of 800 μm and height of 300 μm.

For each resin composition, a case in which the molding die temperature is 120°C and molding time is 5 minutes and the resin composition after cleaning can be removed without adhesion on an internal surface of a molding die is graded "excellent". A case in which the molding time is 8 minutes and the resin composition after cleaning can be removed

without adhesion on an internal surface of a molding die is graded "good". A case in which the molding time is 11 minutes and the resin composition after cleaning can be removed without adhesion on an internal surface of a molding die is graded "acceptable." A case in which 11 minutes or more is required for the molding time is graded "not acceptable".

Incidentally, the die release property was determined by visual observation.

[0051] (Evaluation of Cleaning Property)

The resin composition was repeatedly molded and the number required for removing stain on an internal surface of a molding die was evaluated as the cleaning property. A fewer number indicates a more excellent cleaning property.

By using EME-G700L (manufactured by Sumitomo Bakelite Company Limited), which is a commercially available epoxy resin molding material, 400 shot-molding was carried out at molding die temperature of 150°C so that stain is generated on an internal surface of a molding die. Subsequently, the molding die temperature was lowered to 120°C, and by performing repeated molding of the resin composition till to have removal of the stain on an internal surface, the die cleaning operation was performed. The repeated molding number was 11 at maximum. Incidentally, for the evaluation, the die and the automatic molding machine which have been used in the evaluation of a die release property in the above were used.

As for the evaluation of the cleaning property of each resin composition for cleaning a die, a case in which the repeated molding number is 5 or less and no stain are found on the entire surface of an internal surface of a molding die was graded "excellent". A case in which the repeated molding number is from 6 to 8 was graded "good". A case in which the repeated molding number is from 9 to 11 was graded "acceptable." A case in which the stain are not removed even after repeating the molding 11 times was graded "not acceptable." Incidentally, the cleaning property was determined by visual observation.

[0052] The evaluation results of each resin composition are summarized in Table 1.

[0053] [Table 1]

Component		Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7	Example 8	Example 9	Example 10	Example 11	Example 12	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4
Melamine-based resin	Pulp-incorporated melamine-formaldehyde resin powder	30.0	30.0	30.0	30.0	30.0	-	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	30.0	-
	Pulp-incorporated melaminephenol copolymerization resin powder	-	-	-	-	-	30.0	-	-	-	-	-	-	-	-	-	30.0
	Melamine resin (product name: NIKARESIN S-166)	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
	Luoric acid (45 °C)	-	-	-	-	-	0.10	-	-	-	-	-	-	-	-	-	-
	3-Phenylpropionic acid (50 °C)	-	-	-	-	-	0.10	-	-	-	-	-	-	-	-	-	-
	Maleic anhydride (53 °C)	-	-	-	-	-	0.10	-	-	-	-	-	-	-	-	-	-
	Myristic acid (55 °C)	-	-	-	-	-	-	-	-	-	0.20	0.10	-	-	-	-	-
	Palmitic acid (63 °C)	-	-	-	-	-	0.10	-	-	-	-	-	-	-	-	-	-
	Stearic acid (70 °C)	0.30	-	-	-	-	-	-	-	8.00	-	0.20	-	-	0.30	0.30	-
	Behenic acid (76 °C)	-	0.30	-	0.30	-	0.30	1.00	-	-	-	-	-	-	-	-	0.20
	p-Methoxyphenyl acetic acid (85 °C)	-	-	-	-	0.01	-	-	-	-	-	-	-	-	-	-	-
	o-Tolyl acetic acid (89 °C)	-	-	-	-	-	-	1.00	-	-	-	-	-	-	-	-	-
	p-Tolyl acetic acid (90 °C)	-	-	0.60	-	-	-	-	-	-	-	-	-	-	-	-	-
	Montanic acid (91 °C)	-	-	-	-	-	-	-	0.01	-	-	-	-	-	-	-	-
	Citric acid monohydrate (100 °C)	-	-	-	-	-	0.05	-	-	-	0.10	0.10	0.10	-	-	-	-
	o-Tolyl acid (103 °C)	-	-	-	0.10	0.50	-	0.10	0.20	0.02	-	-	-	-	-	-	-
	m-Tolyl acid (112 °C)	-	-	-	-	-	-	-	0.10	-	-	-	-	-	-	-	-
	Succinic anhydride (119 °C)	-	-	-	-	-	-	-	-	-	0.20	0.10	-	-	-	-	-
	Benzoic acid (122 °C)	0.10	0.10	0.01	-	0.50	0.05	-	-	-	-	-	-	-	-	-	-
	Naphthalene sulfonic acid hydrate (124 °C)	-	-	-	-	-	-	-	-	-	0.10	-	-	-	-	-	-
Inorganic filler	Adipic acid (152 °C)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10	-
	Terephthalic acid (300 °C)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.20
	Silica	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
	Zinc stearate	0.4	-	-	-	0.4	0.4	-	0.4	0.4	0.4	0.4	0.4	0.4	-	-	0.4
	Aluminum stearate	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4	-	-
	Zinc myristate	-	-	0.4	-	-	-	-	-	-	-	-	-	-	-	0.4	-
	Magnesium oleate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Composite of zinc stearate and calcium stearate	-	-	-	-	-	-	0.4	-	-	-	-	-	0.4	-	-	-
	Ethylene bisstearic acid amide	0.4	0.4	0.4	0.4	0.4	0.2	0.4	0.4	0.4	-	-	-	0.2	0.4	0.4	0.4
	Erucic acid amide	-	-	-	-	-	0.2	-	-	-	0.4	0.4	0.4	0.2	-	-	-
Total amount of curing catalyst relative to 100 parts by mass of resin composition for die cleaning		0.40	0.40	0.60	0.40	0.99	0.79	2.04	0.31	7.37	0.40	0.59	0.20	0.49	0.30	0.40	0.40
	Second curing catalyst/First curing catalyst on mass basis	1/3	1/3	60/1	1/3	-	-	-	-	1/400	-	-	1/1	-	-	-	-
	Curing property	Good	Good	Excellent	Good	Good	Excellent	Excellent	Acceptable	Acceptable	Good	Good	Acceptable	Good	Not acceptable	Not acceptable	Not acceptable
	Fluidity	Excellent	Excellent	Good	Excellent	Excellent	Acceptable	Good	Excellent	Acceptable	Excellent	Excellent	Excellent	Not acceptable	Not acceptable	Good	Good
	Die release property	Excellent	Excellent	Good	Excellent	Excellent	Excellent	Excellent	Excellent	Acceptable	Good	Good	Acceptable	Excellent	Not acceptable	Not acceptable	Not acceptable
Cleaning property		Excellent	Excellent	Good	Excellent	Good	Good	Good	Good	Acceptable	Good	Acceptable	Good	Not acceptable	Not acceptable	Not acceptable	Not acceptable
		Excellent	Excellent	Good	Excellent	Good	Good	Good	Good	Acceptable	Good	Acceptable	Good	Not acceptable	Not acceptable	Not acceptable	Not acceptable

[0054] According to the results shown in Table 1, it was found that the resin composition for cleaning a die of each Example, which contains a melamine-based resin, a first curing catalyst having a melting temperature of from 43°C to 115°C, and a second curing catalyst having a melting temperature which is from 53°C to 125°C and which is higher by 10°C or more, than the melting temperature of the first curing catalyst shows an excellent evaluation result in terms of each of the curing property, fluidity (flow), die release property, and cleaning property. Accordingly, it is understood that the resin composition for cleaning a die suppresses excessive curing and excessive flow, and enables more excellent cleaning.

In particular, each resin composition of Examples 1, 2, 4 and 9, in which the first curing catalyst is stearic acid or behenic acid and the second curing catalyst is benzoic acid or o-toluic acid, shows a particularly excellent performance.

Incidentally, according to both of the resin composition having only one of the first curing catalyst and the second curing catalyst like the resin composition of Comparative example 1 or Comparative example 2 and the resin composition in which the second curing catalyst is not contained but the first curing catalyst and a curing catalyst having a melting temperature of more than 125°C are used in combination like the resin composition of Comparative Example 3 or Comparative Example 4, there was a problem in terms of cleaning of an internal surface of a molding die in the molding die temperature range of from 125°C to 150°C.

[0055] As shown in Examples and Comparative Examples above, it was possible to provide a resin composition for cleaning a die which enables, by suppressing excessive curing and excessive resin flow, more excellent cleaning in cleaning of an internal surface of a molding die in a molding die temperature range of from 125°C to 150°C.

[0056] The disclosure of Japanese Patent Application No. 2016-070055 filed on March 31, 2016, is incorporated herein by reference.

All publications, patent applications, and technical criteria mentioned in this specification are herein incorporated by reference to the same extent as if each individual publication, patent application, or technical standard was specifically and individually indicated to be incorporated by reference.

CLAIMS

1. A resin composition for cleaning a die, the resin composition comprising;
a melamine-based resin;
a first curing catalyst having a melting temperature of from 43°C to 115°C; and
a second curing catalyst having a melting temperature that is from 53°C to 125°C and that is higher by 10°C or more, than the melting temperature of the first curing catalyst.
2. The resin composition for cleaning a die according to claim 1, wherein a total content of the first curing catalyst and the second curing catalyst is in a range of from 0.02 part by mass to 9 parts by mass with respect to 100 parts by mass of the resin composition.
3. The resin composition for cleaning a die according to claim 1 or 2, wherein a ratio of a content of the second curing catalyst with respect to a content of the first curing catalyst is in a range of from 400/1 to 1/400, on a mass basis.
4. The resin composition for cleaning a die according to any one of claims 1 to 3, wherein the first curing catalyst comprises at least one selected from the group consisting of stearic acid and behenic acid, and the second curing catalyst comprises at least one selected from the group consisting of benzoic acid and o-toluic acid.
5. The resin composition for cleaning a die according to any one of claims 1 to 4, wherein the resin composition is used to clean a die provided on a transfer-type molding machine.