

DESCRIPTION

RESIN COMPOSITION FOR CLEANING DIE

Technical Field

[0001] The present invention relates to a resin composition for cleaning a die. More specifically, the invention relates to a transfer-type resin composition for cleaning a die, with which a stain originating from a thermosetting resin composition on the inner surface of a molding die is removed.

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 stain originating from the sealing molding material. Generation of such a stain causes a defect of staining the interior of a molding die. Such a stain left in the die causes a defect of 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 in the molding die in the case of performing the sealing molding. Specifically, a resin composition for cleaning a die is molded instead of the sealing molding material at a rate of several shots based on several hundred shots of sealing molding. The stain on the inner surface of the molding die can be removed by molding the resin composition for cleaning a die.

[0003] Such resin compositions for cleaning dies have been conventionally proposed. For example, a resin composition for cleaning a die according to Patent Literature 1 contains from 10 to 70 mass% of an epoxy-modified melamine resin with respect to the total amount of an amino resin, whereby the heat toughness of a molded article obtained by molding in the die cleaning is improved, and efficiency in the cleaning of the die is improved.

[0004] In recent years, the sealing molding shapes and structures of integrated circuits, LED elements, and the like have been diversified and made to be precise for adaptation to the higher performance of instruments used. Therefore, it has been also demanded that the shapes and structures of molding dies used in sealing molding steps are diversified and made to be precise. In cleaning of such a molding die, it is demanded that a stain is removed in every corner of die cavity, including corner portions in which stains tend to remain.

[0005] Patent Literature 1 describes a resin composition for cleaning a die containing 1 mass% of a mineral powder having a maximum particle diameter of 180 μm or less and a

particle diameter of 100 μm or more, with respect to the total amount of mineral powder. It is disclosed that the resin composition for cleaning a die according to Patent Literature 1 has the effect of spreading of the resin composition for cleaning a die into every corner in voids, whereby the efficiency of cleaning a clogging in a narrow gate portion is improved.

However, the effect is insufficient, and has a room for improvement. The resin composition for cleaning a die according to Patent Literature 1 also has a room for improving stain removal efficiency removal performance in a die.

[0006] Clogging in narrow gate portions in die cavity may be suppressed by using a resin composition for cleaning a die in which the grains of a filler are allowed to be smaller, in the case of cleaning a die. However, the smaller grains of the filler have the defect of inferior physical polishing effect of the filler, whereby the stain removal efficiency in a corner portion is particularly deteriorated. Further, a resin composition for cleaning a die in which the grains of the filler are smaller may cause excessive flow of the resin composition for cleaning a die in cleaning. Therefore, the resin composition for cleaning a die has the defect of failing in suitably remaining in a die, whereby it cannot sufficiently remove a stain.

Citation List

Patent Literature

[0007] [Patent Literature 1] Japanese Patent Application Laid-Open (JP-A) No. 2003-62835

SUMMARY OF INVENTION

Technical Problem

[0008] The invention was made in view of the above circumstances. In other words, a resin composition for cleaning a die by which a favorable cleaning effect can be obtained, for example, even in corner portions in die cavities made to be denser, and a stain removal efficiency is improved, is required with respect to the circumstances.

Solution to Problem

[0009] The resin composition for cleaning a die cleaning of the invention is a resin composition for cleaning a die, comprising: a melamine-based resin; an inorganic filler; a curing catalyst; and a salt of a saturated fatty acid and a metal, wherein

the inorganic filler has a spherical shape;

the inorganic filler has a maximum particle diameter of from 1 μm to 70 μm ;

the curing catalyst is at least one of myristic acid or stearic acid; and

the salt of a saturated fatty acid and a metal is zinc myristate.

[0010] In a preferred embodiment of the resin composition for cleaning a die of the invention, the inorganic filler has an average particle diameter of from 4 μm to 10 μm , a standard deviation of particle diameter of 7 μm or less, an average aspect ratio of particle diameter of from 1 to 1.2, and a standard deviation of aspect ratio of 0.3 or less.

[0011] In a preferred embodiment, the resin composition for cleaning a die of the invention is a transfer-type resin composition for cleaning a die, wherein the composition is used in a transfer-type molding machine. In other words, the resin composition for cleaning a die of the invention is preferably used in transfer molding.

Effects of Invention

[0012] In accordance with the invention, a resin composition for cleaning a die, which provides a favorable cleaning effect even in corner portions in die cavities made to be denser, and which has improved stain-removing stain removal efficiency, is provided by specifying the shape and particle diameter range of an inorganic filler and by using a specific curing catalyst and a specific salt of a saturated fatty acid and a metal.

DESCRIPTION OF EMBODIMENTS

[0013] Embodiments of the resin composition for cleaning a die of the invention are explained below.

The resin composition for cleaning a die of the invention includes at least a melamine-based resin, an inorganic filler that has a maximum particle diameter of from 1 μm to 70 μm and has a spherical shape, a curing catalyst selected from myristic acid or stearic acid, and zinc myristate, which is a salt of a saturated fatty acid and a metal. The resin composition for cleaning a die of the invention may further include an additional component, if necessary.

[0014] -Melamine-based resin-

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

The melamine-based resin represents a melamine resin, a melamine-phenol co-condensate, or a melamine-urea co-condensate.

[0015] 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.

[0016] The melamine-phenol co-condensate is a co-condensate of a triazine, a phenol, and an aldehyde. Examples of the phenol include phenol, cresol, xylenol, ethylphenol, and

butylphenol.

[0017] The melamine-urea co-condensate is a co-condensate of a triazine, a urea, and an aldehyde.

[0018] Unless deteriorating the effect of the invention, the resin composition for cleaning a die of the invention may include another resin composition such as an alkyd resin, a polyester resin, an acrylic resin, an epoxy resin, or a rubber, as well as the melamine-based resin.

[0019] The resin composition for cleaning a die of the invention exhibits excellent performance for cleaning a stain on a molding die inner surface 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 having a high polarity, a stain that is generated in molding, adheres to a molding die inner surface, and originates from a sealing molding material (i.e., a stain originating from a sealing molding material containing a thermosetting resin composition), and the resin composition for cleaning a die of the invention can react with the stain. It is also considered that excellent cleaning performance can be stably exerted at from around 160 to 190°C, which is the temperature in cleaning of a die, since the melamine-based resin is thermally stable.

[0020] -Inorganic Filler-

The resin composition for cleaning a die of the invention includes at least one inorganic filler having a maximum particle diameter of from 1 μm to 70 μm and having a spherical shape.

[0021] The inorganic filler used in the invention has a spherical shape. The "spherical shape" refers to a shape of the inorganic filler described below, which has an average aspect ratio of a particle diameter of from 1 to 1.5, encompassing not only a perfectly spherical shape but also an approximately spherical shape, that is an almost spherical shape that can be regarded as being spherical, such as one that has an elliptic cross-section, of which the diameter of a cross section is not uniform.

[0022] The inorganic filler preferably has an average aspect ratio of particle diameter of from 1 to 1.2. Accordingly, the resin composition for cleaning a die of the invention can maintain the fluidity of the resin composition for cleaning a die in cleaning. The resin composition for cleaning a die of the invention is further expected to have a favorable cleaning effect even in corner portions in die cavities made to be denser, and is capable of suppressing abrasion or flawing of a molding die inner surface and a gate portion.

In a case in which the resin composition for cleaning a die includes the inorganic filler having an average aspect ratio of particle diameter of 1.5 or less, the fluidity of the resin

composition for cleaning a die can be kept favorable in cleaning, and favorable cleaning performance can be secured even in corner portions in die cavities made to be denser. Occurrence of abrasion or flawing of a molding die inner surface and a gate portion is also suppressed.

[0023] In the invention, the aspect ratio of particle diameter of the inorganic filler is demanded as follows.

That is, the aspect ratio of particle diameter of the inorganic filler is determined using an electron microscope in a manner similar to a method of determining the particle diameter described below. Each of the major diameter (X) of one inorganic filler and the minor diameter (Y) perpendicular to the major diameter (X) is measured five times. From the obtained measured values, the aspect ratio of particle diameter of one inorganic filler is determined according to an expression described below, with the proviso that major diameter (X) $\geq$ minor diameter (Y) holds.

Aspect ratio of particle diameter = (average value of five-time measured values of X) / (average value of five-time measured values of Y)

Measurement of the aspect ratio of each of the 150 particles of the inorganic filler is performed, and the average of the obtained measured values is determined, and is regarded as the aspect ratio of the particles of the inorganic filler.

[0024] According to the definition in the invention, the aspect ratio of the particle diameter is 1 in a case in which the major diameter (X) is equal to the minor diameter (Y). According to the definition in the invention, the aspect ratio of the particle diameter is not a value of less than 1. The shape of the inorganic filler is spherical, and the more spherical shape means the aspect ratio of particle diameter of being closer to 1. The aspect ratio of particle diameter is 1 even if an inorganic filler imaged by an electron microscope has a square shape; however, each inorganic filler used in the invention has a spherical shape (encompassing an approximately spherical shape), and in the invention, the aspect ratio of particle diameter of being close to 1 means that the shape of the particle is close to the spherical shape.

[0025] In the invention, the average aspect ratio of particle diameter of the inorganic filler is the average value of the aspect ratios of the 150 particles of the inorganic filler measured by the above method. The standard deviation of aspect ratio of the inorganic filler described below is the standard deviation of the aspect ratios of the particle diameters of the 150 particles of the inorganic filler measured by the above method.

[0026] The inorganic filler is, for example, one or more selected from the group consisting of silicon carbide, silicon oxide (silica), titanium carbide, titanium oxide, boron carbide, boron oxide, aluminum oxide, magnesium oxide, and calcium oxide. These inorganic fillers may

be used singly, or in combination of plural kinds thereof.

[0027] The inorganic filler in the invention is preferably silicon oxide (silica) or titanium oxide, and is particularly preferably silicon oxide. As the inorganic filler used in the invention, silicon oxide (silica) or titanium oxide is preferred due to appropriate hardness, and enables to suppress abrasion or flawing of a molding die inner surface and a gate portion, depending on the material and state of the die. The present inventor considers that a stain on a die surface is physically polished with the inorganic filler in cleaning of die cavities made to be denser, whereby the stain is removed. Silicon oxide (silica) and titanium oxide are preferred because of being thermally stable at from around 160 to 190°C, which is employed in cleaning of the die.

[0028] It is desirable that the resin composition for cleaning a die of the invention includes the inorganic filler having a standard deviation of aspect ratio of 0.3 or less. In a case in which the resin composition for cleaning a die of the invention includes the inorganic filler having a standard deviation of aspect ratio of particle diameter of 0.3 or less, the fluidity of the resin composition for cleaning a die is easily kept in cleaning, and therefore, cleaning performance is easily provided even in corner portions in die cavities, and abrasion or flawing of a molding die inner surface and a gate portion can be more suppressed.

Especially, the inorganic filler more preferably has a standard deviation of aspect ratio of from 0.15 to 0.3.

[0029] In the above, the term "die cavities made to be denser" refers to cavities that are minutely and optimally arranged on the whole molding die surface due to downsizing of the cavities. In the die cavities made to be denser, gate portions are also narrower than that of conventional gate portions by the downsizing of the cavities, and the narrowest gate portion is 100 μm .

[0030] The inorganic filler used in the invention has a maximum particle diameter of from 1 μm to 70 μm . In the resin composition for cleaning a die of the invention, the contained inorganic filler has a maximum particle diameter of from 1 μm to 70 μm , and therefore, a favorable cleaning effect can be obtained even in corner portions in die cavities made to be denser. As used herein, a maximum particle diameter of 1 μm or more means that the inorganic filler has a shape which is enough for physically acting on a stain on a die surface. In a case in which the maximum particle diameter exceeds 70 μm , a cavity portion is easily clogged with particles of the inorganic filler, and fluidity is deteriorated, whereby a cleaning effect is deteriorated.

In the above range, the maximum particle diameter of the inorganic filler is more preferably from 10 μm to 50 μm , particularly preferably from 20 μm to 45 μm , most

preferably 45 μm .

[0031] It is desirable that the inorganic filler used in the invention has an average particle diameter of from 4 μm to 10 μm . The inventor considers that in a case in which the inorganic filler has a significantly small average particle diameter, the mass and surface area thereof are small, and therefore, it is difficult to exert the performance of cleaning die cavities. In the resin composition for cleaning a die of the invention, cleaning performance for an overall molding die is more obtained in a case in which the inorganic filler has an average particle diameter of 4 μm or more. In a case in which the inorganic filler has an average particle diameter of 10 μm or less, cleaning performance is more obtained even in corner portions in die cavities made to be denser. Further, in a case in which the inorganic filler in the invention has an average particle diameter of 10 μm or less, abrasion or flawing of a molding die inner surface and a gate portion can be more suppressed.

In the above range, the inorganic filler more preferably has an average particle diameter of from 5 μm to 8 μm .

[0032] It is desirable that the inorganic filler used in the invention has a standard deviation of particle diameter of 7 μm or less. In a case in which the inorganic filler of the resin composition for cleaning a die of the invention has a standard deviation of particle diameter of 7 μm or less, the fluidity of the resin composition for cleaning a die can be kept in cleaning, and therefore, cleaning performance is more obtained even in corner portions in die cavities.

In the above range, the inorganic filler more preferably has a standard deviation of particle diameter of from 1 μm to 7 μm .

[0033] In the invention, the particle diameter of the inorganic filler is demanded as follows.

That is, the inorganic filler was photographed at a magnification of 1500 times using an electron microscope (trade name: JSM-5510, manufactured by JEOL Ltd.) such that about 30 particles of the inorganic filler are included in one visual field, and the diameter of each particle of the inorganic filler in each of different five visual fields was measured. Subsequently, the major diameter (X) of the inorganic filler and the minor diameter (Y) perpendicular to the major diameter (X) were measured, and the average value of five-time measured values was determined. X and Y of 150 particles of the inorganic filler in total were measured, the particle diameter of one particle of the inorganic filler was determined by an expression described below, and the particle diameter of the inorganic filler was determined by averaging the particle diameters (calculated values) of the 150 particles of the inorganic filler.

Particle diameter = ((average value of five-time measured values of X) + (average value of five-time measured values of Y)) / 2

[0034] In the invention, the average particle diameter is the average value of the particle diameters of the 150 particles of the inorganic filler measured by the above method. The standard deviation of particle diameters is the standard deviation of the particle diameters of the 150 particles of the inorganic filler measured by the above method.

[0035] The inorganic filler that can be preferably used in the invention is, for example, amorphous spherical silica, and specific examples thereof include "S440-4", "HS-202", "HS-204", and "UF-320" (trade names, manufactured by Nippon Steel & Sumikin Materials Co., Ltd. Micron Co. (Nippon Steel Materials Co., Ltd., Micron Co.)).

[0036] -Curing Catalyst-

The resin composition for cleaning a die of the invention includes, as a curing catalyst, at least one selected from myristic acid or stearic acid.

In a case in which the inorganic filler having a spherical shape (encompassing an approximately spherical shape) and a maximum particle diameter of from 1 μm to 70 μm is used in the resin composition for cleaning a die, flow of the resin composition for cleaning a die becomes excessive, and the resin composition for cleaning a die does not suitably remain in a die, and therefore, a stain may not be sufficiently removed in cleaning of die cavities made to be denser. The inventors found that the flow of the resin composition for cleaning a die is prevented from becoming excessive in the cleaning of the die cavities made to be denser by the use of myristic acid and/or stearic acid as the curing catalysts.

Accordingly, the resin composition for cleaning a die of the invention suitably remains in a die, whereby corner portions in die cavities made to be denser can be cleaned, and the stain removal efficiency is also improved.

[0037] A content of myristic acid and stearic acid used in the invention in the composition is preferably from 0.1 parts by mass to 3.0 parts by mass, more preferably from 0.5 parts by mass to 2.0 parts by mass, and particularly preferably from 1.0 part by mass to 2.0 parts by mass, with respect to 100 parts by mass of the melamine-based resin. In a case in which the content of the myristic acid is 0.1 parts by mass or more, the resin composition for cleaning a die of the invention is easily cured in cleaning, and a stain in die cavities made to be denser is more favorably removed. In a case in which the myristic acid is 3.0 parts by mass or less, the resin composition for cleaning a die of the invention is superior in storage stability.

[0038] -Salt of Saturated Fatty Acid and Metal-

The resin composition for cleaning a die of the invention includes zinc myristate as a salt of a saturated fatty acid and a metal. The inventor considers that the salt of a saturated fatty acid and a metal acts on a stain, and, for example, the stain swells, whereby it becomes easy to remove the stain from a molding die surface, in cleaning of die cavities made to be

denser. In other words, the inventor found that flow of the resin composition for cleaning a die of the invention is prevented from becoming excessive in the cleaning of the die cavities made to be denser by particularly select the use of zinc myristate as the salt of a saturated fatty acid and a metal.

[0039] Zinc myristate has a melting point of from 123°C to 130°C. Temperature in cleaning of die cavities using a sealing molding material containing a thermosetting resin composition is generally from 160°C to 190°C.

The inventor considers that the flow of the resin composition for cleaning a die of the invention is in a range suitable for cleaning since zinc myristate contained in the resin composition for cleaning a die of the invention exhibits suitable fluidity in a range of from 160°C to 190°C, which is a cleaning operation environment temperature.

Accordingly, the resin composition for cleaning a die of the invention suitably remains in a die, whereby corner portions in die cavities made to be denser can be cleaned, and the performance of cleaning a stain is improved.

[0040] A content of zinc myristate used as a salt of a saturated fatty acid and a metal is preferably from 0.1 parts by mass to 3.0 parts by mass, more preferably from 0.5 parts by mass to 2.0 parts by mass, and particularly preferably from 1.0 part by mass to 2.0 parts by mass, with respect to 100 parts by mass of the melamine-based resin. In a case in which the content of the zinc myristate is 0.1 parts by mass or more, the resin composition for cleaning a die of the invention is easily cured in cleaning, and a stain in die cavities made to be denser is favorably removed. A content of the zinc myristate of 3.0 parts by mass or less is preferred because of resulting in unexcessive flow of the resin composition for cleaning a die of the invention.

[0041] -Other Additives-

The resin composition for cleaning a die of the invention may further include an additional additive. Examples of the additional additive include colorants, antioxidants, and lubricants.

Examples of lubricants include fatty acid amide lubricants, and specific examples thereof include saturated- and unsaturated- monoamide lubricants such as lauric acid amide, myristic acid amide, erucic acid amide, oleic acid amide, and stearic acid amide, and saturated- and unsaturated- bis amide lubricants such as methylenebis stearic acid amide, ethylenebis stearic acid amide, and ethylenebis oleic acid amide.

[0042] The resin composition for cleaning a die of the invention is suitable for removing, from a molding die inner surface, a stain originating from a sealing molding material containing a thermosetting resin composition, of which an epoxy resin, a silicone resin, a

phenolic resin, and a polyimide resin are representative.

[0043] The resin composition for cleaning a die of the invention can be prepared by substantially homogeneously mixing the melamine-based resin, then inorganic filler, the curing catalyst, the salt of a saturated fatty acid and a metal, and an additional additive if necessary. Examples of methods of the substantially homogeneous mixing include methods using a kneader, a ribbon blender, a Henschel mixer, a ball mill, a roll mill, a grinding machine, or a tumbler.

[0044] The resin composition for cleaning a die of the invention is preferable for a transfer-type resin composition for cleaning a die used in a transfer-type molding machine.

[0045] The resin composition for cleaning a die of the invention is generally processed in a tablet form and is generally used in a cleaning operation in a molding die. Specifically, a lead frame is arranged on the die, and the resin composition for cleaning a die in a tablet form is then inserted into a pot portion, mold-clamped, and then swept away by a plunger. At this time, the resin is passed from the pot portion via a runner portion, and flows through a gate portion into a die cavity. A cleaning operation is performed by opening the die after a lapse of predetermined molding time and removing a molded product, which is united with the lead frame and contains the resin composition for cleaning a die and a stain.

[0046] The resin composition for cleaning a die of the invention is preferably used for removing a stain in a molding die in an operation for sealing molding of an integrated circuit or the like. The material of the molding die is, for example, iron, chromium, or the like. The interior of the molding die is generally plated. Due to repetition of a sealing molding operation and an operation for cleaning a molding die inner surface, flaws having micron sizes are generated in the molding die, and the die is abraded. Due to occurrence of such a flaw and an abrasion, chipping of the plated surface in the molding die, roughening of a surface condition or the like occurs. The molding die causes deterioration of moldability and releasability in the sealing molding operation and poor surface appearance due to the generation of the internal flaw and the chipping or the roughening of the surface state of the plated surface in the molding die inner surface. These further cause a defect of deterioration of efficiency in cleaning the inside of the molding die. The resin composition for cleaning a die of the invention enables suppressing flaws in the molding die in cleaning by suitably selecting the maximum particle diameter of the inorganic filler having a spherical shape (encompassing an approximately spherical shape).

EXAMPLES

[0047] The invention will be further specifically explained below with reference to examples

and comparative examples. The invention is not limited to the examples.

[0048] (Example 1)

21.3 parts by mass of melamine-phenol co-condensate produced by heating reaction by a known method and subjected to drying under reduced pressure and powdering and 50 parts by mass of melamine resin as melamine-based resins, 20 parts by mass of amorphous spherical silica (trade name: S440-4, inorganic filler manufactured by Nippon Steel & Sumikin Materials Co., Ltd. Micron Co. (Nippon Steel Materials Co., Ltd. Micron Co.)) as an inorganic filler, 7.8 parts by mass of hardwood pulp as an organic filler, 0.5 parts by mass of zinc myristate as a salt of a saturated fatty acid and a metal, and 0.05 part by mass of myristic acid as a curing catalyst were added in a ball mill and ground. Then, 0.35 parts by mass of stearic acid amide as a lubricant was added by a Nauta mixer. In such a manner, a resin composition for cleaning a die was produced.

[0049] Observation of the inorganic filler with an electron microscope indicated that S440-4 had an average aspect ratio of particle diameter of 1.16 (spherical). Each of the other inorganic fillers used in Examples described below had an average aspect ratio of particle diameter of from 1 to 1.5, which means a spherical shape.

[0050] The composition, amounts (part(s) by mass), and the average particle diameter, the maximum particle diameter, and the average aspect ratio of the inorganic fillers of the resin composition for cleaning a die produced in Example 1 are summarized in Table 1 below.

The standard deviation of the particle diameters of the inorganic fillers was 7 μm , and the standard deviation of the aspect ratios of the inorganic fillers was 0.23.

[0051] The cleaning performance of the produced resin composition for cleaning a die was evaluated by a testing method described below. The produced resin composition for cleaning a die is of a transfer-type.

[0052] -Cleaning Performance-

An automatic molding machine which uses a QFP (Quad Flat Package) die was prepared. 400-shot molding was performed therewith at a die temperature of 175°C using a commercially available epoxy resin molding material EME-G700L (manufactured by Sumitomo Bakelite Co., Ltd.) to form a stain on a molding die inner surface. Using the die, a cleaning operation was performed by repeatedly molding the resin composition for cleaning a die produced as described above until the stain on the inner surface was removed. The repeated molding of the resin composition for cleaning a die was performed at a die temperature of 175°C in a manner similar to that in the molding of the epoxy resin molding material.

A gate portion in a die cavity used for the evaluation had a width of 800 μm and a

height of 300 μm . The narrowest site of the gate portion of the die cavity was 100 μm .

[0053] Attention was paid particularly to whether cleaning was able to be performed even in the gate and corner portions in the die cavity, and the cleaning performance was evaluated by judging the stain removal efficiency in the corner portion in the die cavity, and the number of shots necessary for cleaning the gate and corner portions in the die cavity. The smaller number of shots means the superior cleaning performance. In Table 1, evaluation results in each of Examples and Comparative Examples are summarized.

The stain removal efficiency in the corner portion was evaluated by visually observing the presence or absence of a stain in the corner portion in the die cavity. In the evaluation, a favorable case in which the resin composition for cleaning a die favorably passed through the gate portion in the die cavity and a stain was absent or small in amount was judged as "A", while a case in which a stain remained and caused a defect in molding was judged as "B".

In the evaluation of the number of shots necessary for cleaning in the gate and corner portions in the die cavity, the number of shots was recorded in a case in which the number of shots for completion was ten or less, while a case in which a stain could not be removed by ten-time cleaning was judged as "NG".

[0054] (Example 2)

A resin composition for cleaning a die was produced and the cleaning performance thereof was evaluated in the same manner as in Example 1, except that myristic acid used as the curing catalyst in Example 1 was changed to stearic acid. The evaluation results are listed in Table 1.

[0055] (Examples 3 to 5)

A resin composition for cleaning a die was produced and the cleaning performance thereof was evaluated in the same manner as in Example 1, except that the inorganic filler in Example 1 was changed as listed in Table 1 below. The evaluation results are listed in Table 1.

[0056] (Comparative Example 1)

A resin composition for cleaning a die was produced and the cleaning performance thereof was evaluated in the same manner as in Example 1, except that benzoic acid was used as the curing catalyst in Example 1. The evaluation results are listed in Table 1.

[0057] (Comparative Example 2)

A resin composition for cleaning a die was produced and the cleaning performance thereof was evaluated in the same manner as in Example 1, except that zinc stearate was used as the salt of a saturated fatty acid and a metal in Example 1. The evaluation results are

listed in Table 1.

[0058] (Comparative Example 3)

A resin composition for cleaning a die was produced and the cleaning performance thereof was evaluated in the same manner as in Example 1, except that crystalline silica (trade name: R-1, manufactured by Yamamori Tsuchimoto Mining CO., LTD.) was used as the inorganic filler in Example 1. The evaluation results are listed in Table 1.

The inorganic filler used in Comparative Example 3 had the particle diameter and the aspect ratio listed in Table 1, and the shape of the inorganic filler was checked using an electron microscope and found as being an indefinite shape.

[0059] (Comparative Example 4)

A resin composition for cleaning a die was produced and the cleaning performance thereof was evaluated in the same manner as in Example 1, except that crystalline silica (trade name: PURE SILICA POWDER, manufactured by SETO CERAMIC RAW MATERIALS CO., LTD.) was used as the inorganic filler in Example 1. The evaluation results are listed in Table 1.

The inorganic filler used in Comparative Example 4 has the particle diameter and the aspect ratio listed in Table 1

[0060] (Comparative Example 5)

A resin composition for cleaning a die was produced and the cleaning performance was evaluated in the same manner as in Example 1, except that the inorganic filler in Example 1 was changed as listed in Table 1 below. The evaluation results are listed in Table 1.

[0061] [Table 1]

	Component		Average particle diameter [μm] of inorganic filler	Maximum particle diameter [μm] of inorganic filler	Average aspect ratio of inorganic filler	Example 1	Example 2	Example 3	Example 4	Example 5	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5
Composition (part(s) by mass)	Melamine resin	Melamine-phenol co-condensate	-	-	-	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3
		Melamine resin	-	-	-	50	50	50	50	50	50	50	50	50	50
	Inorganic filler	S440-4	7.1	45	1.16 (spherical)	20	20	-	20	20	20	20	-	-	-
		HS-202	16.0	53	1.17	-	-	20	-	-	-	-	-	-	-
		R-1	25.8	352	1.79 (indefinite)	-	-	-	-	-	-	-	20	-	-
		PURE SILICA POWDER	12.8	100	1.65 (non-spherical)	-	-	-	-	-	-	-	-	20	-
		HS-302	7.0	75	1.17	-	-	-	-	-	-	-	-	-	20
		UF-320	3.6	10	1.10	-	-	-	20	-	-	-	-	-	-
		HS-204	11.5	32	1.12	-	-	-	-	20	-	-	-	-	-
		Curing catalyst	Myristic acid	-	-	-	0.05	-	0.05	0.05	0.05	-	0.05	0.05	0.05
	Stearic acid		-	-	-	-	0.05	-	-	-	-	-	-	-	-
	Benzoic acid		-	-	-	-	-	-	-	-	0.05	-	-	-	-
	Salt of saturated fatty acid and metal	Zinc myristate	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	-	0.5	0.5	0.5
		Zinc stearate	-	-	-	-	-	-	-	-	-	0.5	-	-	-
	Organic filler	Hardwood pulp	-	-	-	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8	7.8
	Lubricant	Stearic acid amide	-	-	-	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Evaluation: Cleaning Performance		Performance of stain removal in corner portion, and 100 μm-gate passing performance				A	A	A	A	A	A	A	B	B	B
		Number of shots for completion of cleaning				4	4	4	4	4	7	8	NG	NG	NG

[0062] Details of the inorganic fillers in Table 1 are as follows:

·S440-4: Amorphous spherical silica manufactured by Nippon Steel & Sumikin Materials Co., Ltd. Micron Co. (Nippon Steel Materials Co., Ltd. Micron Co.)

·HS-202: Amorphous spherical silica manufactured by Nippon Steel & Sumikin Materials Co., Ltd. Micron Co. (Nippon Steel Materials Co., Ltd. Micron Co.)

·R-1: Crystalline silica manufactured by Yamamori Tsuchimoto Mining CO., LTD.

·HS-302: Amorphous spherical silica manufactured by Nippon Steel & Sumikin Materials Co., Ltd. Micron Co. (Nippon Steel Materials Co., Ltd. Micron Co.)

·UF-320: Amorphous spherical silica manufactured by Tokuyama Corporation

·HS-204: Amorphous spherical silica manufactured by Nippon Steel & Sumikin Materials Co., Ltd. Micron Co. (Nippon Steel Materials Co., Ltd. Micron Co.)

·PURE SILICA POWDER: Crystalline silica manufactured by Seto Ceramic Raw Materials Co., Ltd.

[0063] The resin composition for cleaning a die of the invention was capable of performing favorable cleaning even in the corner portion in the die cavity made to be denser, and of improving the stain removal efficiency, as shown in Table 1.

[0064] As listed in Table 1, the resin composition for cleaning a die in each of Examples 1 to 5 exhibited the excellent stain removal efficiency, in which favorable cleaning was able to be performed even in the corner portion in the die in which the narrowest site in the gate portion was 100 μm , and the number of shots for completion of cleaning was as small as four, because of including the melamine-based resin, the inorganic filler that was spherical and had a maximum particle diameter of from 1 μm to 70 μm , myristic acid or stearic acid as the curing catalyst, and zinc myristate as the salt of a saturated fatty acid and a metal. It was found from observation of the die surface after the cleaning that the resin composition for cleaning a die in each of Examples 1 to 5 did not flaw a die surface.

[0065] In contrast, since the resin composition for cleaning a die of Comparative Example 1 includes benzoic acid as a curing catalyst, the flow of the resin composition for cleaning a die was excessive, and the number of shots for completion of the cleaning was large.

Accordingly, the stain removal efficiency was inferior to that of Example 1.

[0066] Since the resin composition for cleaning a die of Comparative Example 2 includes zinc stearate as a salt of a saturated fatty acid and a metal, the flow of the resin composition for cleaning a die was excessive, and the number of shots for completion of the cleaning was large. Accordingly, the stain removal efficiency was inferior to that of Example 1.

[0067] In the resin composition for cleaning a die of Comparative Example 3, it was

impossible to clean the corner portion in the die cavity, and the stain removal efficiency on the die was also poor, since the inorganic filler had a maximum particle diameter of 352 μm and an indefinite shape.

[0068] In the resin composition for cleaning a die of Comparative Example 4, it was difficult to clean the corner portion in the die cavity even though the flow of the resin composition for cleaning a die was suitable, since the inorganic filler had a maximum particle diameter of 100 μm . The stain removal efficiency on the die was also poor.

[0069] The resin composition for cleaning a die of Comparative Example 5, in which the inorganic filler had a maximum particle diameter of 75 μm , exhibited a tendency that the cavity portion was easily clogged with particles, and it was impossible to secure favorable fluidity and to favorably clean the corner portion in the die cavity. Accordingly, the stain removal efficiency on the die was also poor.

[0070] As described in the Examples and the Comparative Examples, in a case in which the inorganic filler had a maximum particle diameter of from 1 μm to 70 μm , the flow in cleaning with the resin composition for cleaning a die was able to be regulated by suitably selecting the curing catalyst and the salt of a saturated fatty acid and a metal, and a favorable cleaning effect was exhibited even in the corner portion in the die cavity made to be denser. The resin composition for cleaning a die suitably remained in the die, and the stain removal efficiency in the die was also improved.

Industrial Applicability

[0071] The resin composition for cleaning a die of the invention is a resin composition for cleaning a die, with which a stain originating from a thermosetting resin composition on a die surface is removed, and is preferably used in transfer molding in a transfer-type molding machine.

[0072] The disclosure of Japanese Application No. 2012-011544 is incorporated herein by reference in its entirety.

All the literature, patent applications, and technical standards described herein are herein incorporated by reference to the same extent as if each individual literature, patent application, or technical standard was specifically and individually indicated as being incorporated by reference.

CLAIMS

1. A resin composition for cleaning a die, comprising:
a melamine-based resin;
an inorganic filler that has a maximum particle diameter of from 1 μm to 70 μm and has a spherical shape;
a curing catalyst selected from myristic acid or stearic acid; and
zinc myristate, which is a salt of a saturated fatty acid and a metal.
2. The resin composition for cleaning a die according to claim 1, wherein the inorganic filler has an average particle diameter of from 4 μm to 10 μm , a standard deviation of particle diameter of 7 μm or less, an average aspect ratio of particle diameter of from 1 to 1.2, and a standard deviation of an aspect ratio of 0.3 or less.
3. The resin composition for cleaning a die according to claim 1 or claim 2, wherein the resin is used in a transfer-type molding machine.