

MOLD CLEANING COMPOSITION AND MOLD CLEANING MATERIAL, AND METHOD FOR CLEANING MOLD USING THE SAME

FIELD OF THE INVENTION

5 [0001]

The present invention relates to a mold cleaning composition and a mold cleaning material to be used for cleaning, renewing, and the like of molds that have been contaminated by repetitive molding work such as injection molding or transfer molding, for example, molds for semiconductor device molding used for molding work of a thermosetting resin composition, and the like, and a method for cleaning a mold using the same.

BACKGROUND OF THE INVENTION

[0002]

15 In general, when molding work such as injection molding or transfer molding is repeated, a mold is contaminated by deposition of a volatile component generated at the time when a molding material is heated, an exuded substance onto the surface of a molded article, a release agent to be used at molding, and the like, and further by degradation of these deposits through oxidation. When the mold is thus contaminated, harmful influences are imparted on finished dimension, appearance, releasing property, and the like of the molded article and hence the contamination is not preferable.

[0003]

25 Accordingly, in order to prevent the harmful influences induced by such a contaminated mold, the mold to be used in injection molding or transfer molding is subjected to periodic cleaning work and the above contaminants should be removed

from the mold surface. As a conventional cleaning method of a mold, for example, there is known a cleaning method using a strong alkali solution or a solvent with detaching the mold from a molding apparatus.

[0004]

5 However, the cleaning method using a strong alkali solution or a solvent with detaching the mold from the molding apparatus requires steps of cooling/temperature elevation, detachment, and cleaning of the mold and there is a problem of requirement of a long time for cleaning and also problems of a large amount of labor and further large burdens on human and the environment, such as harmful
10 influences on workers by the use of the strong alkali solution and the solvent and waste liquid treatment after cleaning.

[0005]

For the reasons, there has been proposed and partially practiced a method in which a mold surface is cleaned by using a thermosetting melamine resin molding
15 material, an unvulcanized rubber compound, or the like, combining contaminants formed on the mold surface with a molded article by molding the article in the mold using them, and removing the molded article from the mold (e.g., see Patent Document 1).

[0006]

20 Patent Document 1: JP-A-10-226799

SUMMARY OF THE INVENTION

[0007]

For example, a mold for semiconductor device molding used in molding
25 work of thermosetting resin compositions cleaned by the above-described method but the above thermosetting resin compositions have different component composition

depending on the required characteristic properties and are diversified. Also, the state of mold contamination generated by repetitive molding work and components of the contaminants themselves are multifarious. Among all, contaminants formed on a mold at the time when molding is repeated using a non-halogen environment-friendly resin molding material free from environmental burden substances represented by lead and halogens are particularly severely baked on the mold surface and thus it is impossible to completely remove the contaminants by the conventional cleaning method using the aforementioned thermosetting resin composition or unvulcanized rubber compound. Thus, a cleaning material capable of cleaning such contaminants has been desired.

[0008]

The invention is devised in consideration of such circumstances, and an object thereof is to provide a mold cleaning composition and a mold cleaning material exhibiting an excellent cleaning effect against a mold contaminated by repetitive molding work and also a mold cleaning method using the same.

[0009]

For achieving the above object, the first aspect of the invention lies on a mold cleaning composition for heat molding in which molding is repeatedly performed using a molding material, including: at least one of a synthetic rubber and a synthetic resin which serves as a base material; at least one of an alkali metal salt and an alkali metal hydroxide; and at least one of water and an organic solvent.

[0010]

Moreover, the second aspect of the invention lies on a mold cleaning material formed into a sheet-like shape using the mold cleaning composition.

[0011]

Furthermore, the third aspect of the invention lies on a method for cleaning a mold, the method including: a step of placing a mold cleaning material including the

mold cleaning composition on a mold plane of an opened mold; a step of combining contaminants formed on a surface of the mold with the mold cleaning material by clamping the mold to sandwich the mold cleaning material, followed by heating and pressurizing; and a step of cleaning the surface of the mold by peeling off the mold
5 cleaning material combined with the contaminants from the mold.

[0012]

Namely, the present inventors have extensively studied for obtaining a cleaning composition capable of effectively cleaning and removing even the contaminants formed on the mold at the time when molding is repeated using the non-
10 halogen environmental-friendly resin molding material, as mentioned above. As a result, they have found that, when at least one of a synthetic rubber and a synthetic resin which serves as a base material, at least one of an alkali metal salt and an alkali metal hydroxide, and at least one of water and an organic solvent are contained, an action of dissolution and decomposition of the contaminants is induced by the action of the water
15 or the organic solvent and also an action of promoting the action of dissolution and decomposition of the contaminants is served by the co-presence of at least one of the alkali metal salt and the alkali metal hydroxide, so that a further more excellent cleaning effect is exhibited through a synergistic action thereof, as compared with the conventional method. Thus, they have reached the invention.

20 [0013]

As above, the mold cleaning composition of the invention contains at least one of a synthetic rubber and a synthetic resin which serves as a base material, at least one of an alkali metal salt and an alkali metal hydroxide, and at least one of water and an organic solvent as essential components. Accordingly, even against contaminants
25 formed by repetitive molding work, especially contaminants, which are difficult to sufficiently clean with any conventional cleaning composition, formed on a mold

surface at the time when molding work is repeated using a non-halogen environment-friendly resin molding material free from environmental burden substances represented by lead, halogens, and antimony in a thermosetting resin composition, an action of dissolution and decomposition of the contaminants is induced by the action of the water
5 or the organic solvent and also, by the co-presence of at least one of the alkali metal salt and the alkali metal hydroxide, an excellent cleaning/removing effect is exhibited through a synergistic action of an effect of promoting the action of dissolution and decomposition of the contaminant. Therefore, the contaminants formed on the mold surface are attached to and combined with the mold cleaning composition and thus the
10 contaminants are effectively removed from the mold by cleaning the mold surface using the mold cleaning composition of the invention. For example, contaminants on the surface of a mold for semiconductor element encapsulation in which repetitive molding has been performed using an epoxy resin composition are combined with a molded article including the mold cleaning composition and the contaminants are effectively
15 removed from the mold, whereby cleaning of the mold is effectively performed. As a result, the semiconductor devices formed using the mold cleaned with the mold cleaning composition of the invention are obtained as excellent products without any problem also in appearance. Also, after a mold cleaning material including the mold cleaning composition of the invention is placed on the mold plane of an opened mold,
20 contaminants formed on the surface of the mold are combined with the mold cleaning material by clamping the mold to sandwich the mold cleaning material and heating and pressurizing it and then, by peeling off the mold cleaning material combined with the contaminants from the mold, whereby it becomes possible to clean the mold surface.

[0014]

Particularly, when the synthetic rubber is at least one of ethylene-propylene rubber and butadiene rubber, the handling at the mold cleaning becomes easy and thus an improvement in cleaning workability is realized.

5 [0015]

Moreover, when a content of at least one of the alkali metal salt and the alkali metal hydroxide is set to a specific ratio with respect to 100 parts of at least one of the synthetic rubber and the synthetic resin which serves as a base material, further more excellent cleaning action is obtained.

10 [0016]

Furthermore, when water is contained together with the organic solvent and a content of water is set to a specific ratio with respect to 100 parts of at least one of the synthetic rubber and the synthetic resin which serves as a base material, further more excellent cleaning action is obtained.

15

DETAILED DESCRIPTION OF THE INVENTION

[0017]

The following will describe embodiments of the invention in detail.

[0018]

20 The mold cleaning composition of the invention is obtained using at least one of a synthetic rubber and a synthetic resin which serves as a base material, at least one of an alkali metal salt and an alkali metal hydroxide, and at least one of water and an organic solvent as essential components.

[0019]

25 The synthetic rubber is a so-called unvulcanized rubber and examples thereof include ethylene- α -olefin rubbers such as natural rubber (NR), butadiene rubber

(BR), nitrile rubber (NBR), and ethylene-propylene rubber (EPR), styrene-butadiene rubber (SBR), polyisoprene rubber (IR), butyl rubber (IIR), silicone rubber (Q), and fluorinated rubber (FKM). They may be used singly or two or more thereof may be used in combination. In the invention, the ethylene- α -olefin rubbers include ethylene-
5 α -olefin-polyene rubbers such as ethylene-propylene-polyene rubber (EPDM). These unvulcanized rubbers are vulcanized in the mold to form vulcanized rubbers.

[0020]

Among the above synthetic rubbers, in view of little contaminating property at the molding using a mold and little odor at the vulcanization, EPR (inclusive of
10 EPDM) and BR are preferably used singly or as a mixture thereof.

[0021]

Then, the above EPDM is described in detail. EPDM is a terpolymer composed of ethylene, an α -olefin (particularly, propylene), and a polyene monomer as illustrated below. As the polyene monomer, dicyclopentadiene, 1,5-cyclooctadiene,
15 1,1-cyclooctadiene, 1,6-cyclododecadiene, 1,7-cyclododecadiene, 1,5,9-cyclododecatriene, 1,4-cycloheptadiene, 1,4-cyclohexadiene, norbornadiene, methylenenorbornene, 2-methyl-1,4-pentadiene, 1,5-hexadiene, 1,6-heptadiene, methyltetrahydroindene, 1,4-hexadiene, and the like may be mentioned.

[0022]

20 With regard to the copolymerization ratio of respective monomers in the above EPDM, preferred is a terpolymer in which ethylene is 30 to 80 mol%, polyene monomer is 0.1 to 20 mol%, and rest being α -olefin. More preferably, ethylene is 30 to 60 mol%.

[0023]

25 As the above BR, 1,2-polybutadiene and 1,4-polybutadiene are used singly or as a mixture in which they are used in combination.

[0024]

Examples of the synthetic resin include polyamide resins such as Nylon 6 and Nylon 66, polyester resins such as polyethylene terephthalate, and polybutylene terephthalate, polycarbonate resins, polyarylate resins, vinyl chloride resins, chlorinated vinyl chloride resins, polyethylene resins, chlorinated polyethylene resins, chlorinated polypropylene resins, polypropylene resins, polystyrene resins, acrylonitrile-styrene resins, vinylidene chloride resins, vinyl acetate resins, polyacrylate resins, polyimide resins, butadiene resins, polyacetal resins, ionomer resins, ethylene-vinyl chloride copolymer resins, ethylene-vinyl acetate copolymer resins, ethylene-vinyl acetate-vinyl chloride graft polymerization resins, polyphenylene resins, polysulfone resins, methacrylic resins, acrylic-fluorocarbon resins, acrylic-silicone oligomers, silicone resins, epoxy-containing silicone-acrylic resins, vinyl ester resins, furan resins, phenol resins, melamine resins, guanamine resins, urea resins, polyurethane resins, diacrylic phthalate resins, ketone resins, epoxy resins, xylene resins, maleic resins, phenoxy resins, chroman resins, polyvinyl formal resins, and polyvinylbutyral resins. They may be used singly or two or more thereof may be used in combination. Among these synthetic resins, in view of little contamination at the molding using a mold, polyethylene resins, epoxy resins, and melamine resins are suitably used.

[0025]

In the base material including at least one of the synthetic rubber and the synthetic resin, the synthetic rubber or the synthetic resin may be used singly or the synthetic rubber and the synthetic resin may be used in combination or a plural kinds of them may be used in combination. Of these, in view of easiness of handling at mold cleaning, the synthetic rubbers, polyethylene resins, epoxy resins, and melamine resins are suitably used. Particularly, the use of the above synthetic rubbers is preferable.

Among the synthetic rubbers, as mentioned above, EPR is preferably singly used, or a mixture of EPR and BR is preferably used.

[0026]

As the base material, the mixing ratio (x/y) of EPR (x) and BR (y) in the case where the mixture of EPR and BR is used is preferably set to a range of x/y = 100/0 to 20/80 as a weight ratio. Particularly preferred is a range of x/y = 70/30 to 30/70. Namely, when EPR is less than 20 (ER is more than 80) in the mixing ratio of both materials, at the removal of a rubber molded article during the molding work, the strength of the molded article decreases, so that inconvenience such as breakage is apt to occur and thus the removing work from the mold tends to be difficult.

[0027]

The base material including at least one of the synthetic rubber and the synthetic resin is preferably in a cured state at the time of detachment from the mold at the removal of contamination. The curing method for achieving the above cured state includes curing by heating, curing by cooling in the case of thermoplastic resins or the like, and the like. For example, in the case of the curing by heating, a curing agent is used.

[0028]

The above curing agent may be one capable of curing the base material, and examples thereof include organic peroxides and the like for synthetic rubbers and polyethylene resins. In the case of epoxy resins, there may be mentioned phenol compounds, amine-based compounds, imidazoles, acid anhydride-based curing agents, organic phosphoric acid compounds, and the like.

[0029]

Examples of the above organic peroxides include organic peroxides such as 1,1-bis(t-butylperoxy)-3,3,5-trimethylcyclohexane, 1,1-bis(t-butylperoxy)cyclohexane,

t-butylperoxymaleic acid, t-butyl peroxyoleate, t-butyl peroxy-3,3,5-trimethylhexanoate, cyclohexanone peroxide, t-butyl peroxyaryl carbonate, t-butyl peroxyisopropyl carbonate, 2,5-dimethyl-2,5-di(benzoylperoxy)hexane, 2,2-bis(t-butylperoxy)octane, t-butyl peroxyacetate, 2,2-bis(t-butylperoxy)butane, t-butyl peroxybenzoate, n-butyl-4,4-bis(t-butylperoxy)valerate, di-t-butyl peroxyisophthalate, methyl ethyl ketone peroxide, dicumyl peroxide, 2,5-dimethyl-2,5-di(t-butylperoxy)hexane, α,α' -bis(t-butylperoxy-m-isopropyl)benzene, t-butyl cumyl peroxide, diisopropylbenzene hydroperoxide, di-t-butyl peroxide, and 2,5-dimethyl-2,5-di(t-butylperoxy)hexane-3.

10 [0030]

Examples of the phenol compounds include hydroquinone, resorcinol, and catechol which are monocyclic bifunctional phenols; bisphenol A, bisphenol F, naphthalenediols, and biphenols which are polycyclic bifunctional phenols; and polyfunctional phenols such as halogenides and alkyl group-substituted compounds thereof.

15

[0031]

Examples of the amine-based compounds include N,N-benzyl dimethylamine, 2-(dimethylaminomethyl)phenol, 2,4,6-tris(dimethylaminomethyl)phenol, tetramethylguanidine, triethanolamine, N,N'-dimethylpiperazine, 1,4-diazabicyclo[2.2.2]octane, 1,8-diazabicyclo[5.4.0]-7-undecene, 1,5-diazabicyclo[4.4.0]-5-nonene, hexamethylenetetramine, pyridine, picoline, piperidine, pyrrolidine, dimethylcyclohexylamine, dimethylhexylamine, cyclohexylamine, diisobutylamine, di-n-butylamine, diphenylamine, N-methylaniline, tri-n-propylamine, tri-n-octylamine, tri-n-butylamine, triphenylamine, tetramethylammonium chloride, tetramethylammonium bromide,

25

tetramethylammonium iodide, triethylenetetramine, diaminodiphenylmethane, diaminodiphenyl ether, dicyandiamide, tolylbisguanide, guanylurea, and dimethylurea.

[0032]

Examples of the imidazoles include imidazole, 2-ethylimidazole, 2-ethyl-4-methylimidazole, 2-methylimidazole, 2-phenylimidazole, 2-undecylimidazole, 1-benzyl-2-methylimidazole, 2-heptadecylimidazole, 4,5-diphenylimidazole, 2-methylimidazoline, 2-phenylimidazoline, 2-undecylimidazoline, 2-heptadecylimidazoline, 2-isopropylimidazole, 2,4-dimethylimidazole, 2-phenyl-4-methylimidazole, 2-ethylimidazoline, 2-phenyl-4-methylimidazoline, benzimidazole, 1-cyanoethylimidazole, and 2,4-diamino-6-[2'-methylimidazolyl-(1')]*s*-triazine.

[0033]

Examples of the acid anhydride-based curing agents include acid anhydrides such as phthalic anhydride, hexahydrophthalic anhydride, pyromellitic dianhydride, and benzophenonetetracarboxylic dianhydride.

15 [0034]

Examples of the organic phosphoric acid compounds include hexamethylphosphoric triamide, tri(dichloropropyl) phosphate, tri(chloropropyl) phosphate, triphenyl phosphite, trimethyl phosphate, phenylphosphonic acid, triphenylphosphine, tri-*n*-butylphosphine, diphenylphosphine organophosphorus compounds, and halides thereof.

[0035]

These curing agents may be used singly or may be used as any combination of two or more thereof.

[0036]

25 The mixing amount of the curing agent is appropriately set but, for example, in the case of the synthetic rubber, the amount is preferably set to a range of 1

to 3 parts by weight with respect to 100 parts by weight (hereinafter, simply referred to as “part(s)”) of the synthetic rubber.

[0037]

Furthermore, the curing agent has not only a function of heat curing of the synthetic rubber and the synthetic resin but also a function as a cleaning agent of a mold, and thus can be mixed in the mold cleaning composition of the invention for the purpose other than one as a curing agent, according to need. The mixing amount of the curing agent in such a case is set preferably to 5 to 60 parts, particularly preferably to 5 to 25 parts with respect to 100 parts of at least one of the synthetic rubber and the synthetic resin.

[0038]

Of the at least one of an alkali metal salt and an alkali metal hydroxide to be mixed in the base material, as the alkali metal salt, salts of metals such as lithium, sodium, potassium, rubidium, and cesium may be mentioned.

[0039]

Examples of such an alkali metal salt include boric acid salts, salts of phosphoric acids such as phosphoric acid, metaphosphoric acid, hypophosphoric acid, phosphorous acid (phosphonic acid), hypophosphorous acid (phosphinic acid), pyrophosphoric acid, trimetaphosphoric acid, tetrametaphosphoric acid, and pyrophosphorous acid, carbonic acid salts, sulfuric acid salts, nitric acid salts, hydrochloric acid salts, and salts of organic acids such as acrylic acid, adipic acid, ascorbic acid, aspartic acid, aminobenzoic acid, alginic acid, benzoic acid, oleic acid, formic acid, citric acid, glycolic acid, gluconic acid, glutamic acid, cinnamic acid, succinic acid, acetic acid, salicylic acid, oxalic acid, tartaric acid, toluenesulfonic acid, nicotinic acid, lactic acid, uric acid, halogen-substituted acetic acid, phthalic acid, benzenesulfonic acid, malonic acid, butyric acid, and malic acid.

[0040]

In the case where the alkali metal salt is a salt of a polybasic acid, a partial alkali metal salt of the acid can be utilized. For example, in the case of a salt of tribasic phosphoric acid, the salt may be any of a primary salt having one metal and two hydrogens, a secondary salt having two metals and one hydrogen, and a tertiary salt having three metals. Moreover, it may be any of an acidic salt, an alkaline salt, and a neutral salt. Among them, from the viewpoint of corrosiveness of a mold, an alkaline salt or a neutral salt is preferable. Furthermore, as the alkali metal salt, from the viewpoint of solubility in water, a hydrate is preferably used.

[0041]

Examples of the alkali metal hydroxide include sodium hydroxide and potassium hydroxide.

[0042]

These alkali metal salt and alkali metal hydroxide may be used singly or two or more thereof may be used in combination.

[0043]

The contents of the at least one of the alkali metal salt and the alkali metal hydroxide is set to a range of preferably 0.1 to 10 parts, particularly preferably 0.1 to 5 parts with respect to 100 parts of the at least one of the synthetic rubber and the synthetic resin which serves as a base material. Namely, when the mixing amount is too small, the removing property of the contaminants formed on the mold surface remarkably decreases and complete removal of the mold contamination tends to be difficult. On the other hand, when the amount is too large, the alkali metal salt and the alkali metal hydroxide are apt to precipitate on the mold surface and thus the mold tends to be contaminated to the contrary.

[0044]

Next, as water to be mixed in the invention, tap water, RO water (water treated through a reverse osmosis membrane) obtained by removing impurities, ion-exchange water, and the like can be suitably used.

[0045]

The mixing amount of the water is set to a range of preferably 3 to 30 parts, particularly preferably 5 to 20 parts with respect to 100 parts of at least one of the synthetic rubber and the synthetic resin which serves as a base material. Namely, when the mixing amount is too small, the removing property of the contaminants formed on the mold surface remarkably decreases and complete removal of the mold contamination tends to be difficult. Contrarily, when the amount is too large, the cleaning effect is not improved and a labor for mixing increases and tends to be fruitless.

[0046]

Next, as the organic solvent to be used in the invention, various organic solvents are used and, for example, in the case of using the alkali metal salt, from the viewpoint of the solubility, amide-based solvents, alcohol-based solvents, ketone-based solvents, ether-based solvents, and the like are used. They may be used singly or two or more thereof may be used in combination.

[0047]

As the above amide-based solvents, formamide, N-methylformamide, N,N-dimethylformamide, N,N-diethylformamide, acetamide, N-methylacetamide, N,N-dimethylacetamide, N,N,N',N'-tetramethylurea, 2-pyrrolidone, N-methyl-2-pyrrolidone, caprolactam, carbamic acid esters, and the like are preferably used.

[0048]

Examples of the alcohol-based solvents include methanol, ethanol, 1-propanol, 2-propanol, 1-butanol, 2-butanol, iso-butanol, tert-butanol, 1-pentanol, 2-pentanol, 3-pentanol, 2-methyl-1-butanol, isopentyl alcohol, tert-pentyl alcohol, 3-methyl-2-butanol, neopentyl alcohol, 1-hexanol, 2-methyl-1-pentanol, 4-methyl-2-pentanol, 2-ethyl-1-butanol, 1-heptanol, 2-heptanol, 3-heptanol, cyclohexanol, 1-methylcyclohexanol, 2-methylcyclohexanol, 3-methylcyclohexanol, 4-methylcyclohexanol, ethylene glycol, ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, ethylene glycol monopropyl ether, ethylene glycol monobutyl ether, diethylene glycol, diethylene glycol monomethyl ether, diethylene glycol monoethyl ether, diethylene glycol monopropyl ether, diethylene glycol monobutyl ether, triethylene glycol, triethylene glycol monomethyl ether, triethylene glycol monoethyl ether, tetraethylene glycol, polyethylene glycol (having a weight-average molecular weight of 200 to 400), 1,2-propanediol, 1,3-propanediol, 1,2-butanediol, 1,3-butanediol, 1,4-butanediol, 2,3-butanediol, 1,5-pentanediol, glycerin, propylene glycol, and dipropylene glycol.

[0049]

Examples of the ketone-based solvents include acetone, methyl ethyl ketone, 2-pentanone, 3-pentanone, 2-hexanone, methyl isobutyl ketone, 2-heptanone, 4-heptanone, diisobutyl ketone, cyclohexanone, methylcyclohexanone, phorone, and isophorone.

[0050]

Examples of the ether-based solvents include dipropyl ether, diisopropyl ether, dibutyl ether, dihexyl ether, anisole, phenetole, dioxane, tetrahydrofuran, acetal, ethylene glycol dimethyl ether, ethylene glycol diethyl ether, diethylene glycol dimethyl ether, and ethylene glycol diethyl ether.

[0051]

Also, other than the above organic solvents, solvents such as hydrocarbons, halogenated hydrocarbons, phenols, acetals, aliphatic acids, acid anhydrides, ester compounds, nitrogen compounds, amine compounds (monoethanolamine etc.), and sulfur compounds (dimethyl sulfoxide etc.), and solvents having two or more functional groups (ester and ether, alcohol and ether, etc.) can be used. These solvents may be used singly or two or more thereof may be used in combination (e.g., combinations of amide-based solvents themselves, an amide-based solvent and a solvent other than an amide-based solvent). Furthermore, together with these solvents, other solvents may be used in combination and, for example, it is possible to mix ammonia as an inorganic solvent or the like.

[0052]

In the invention, in the case of using an alkali metal salt, from the viewpoint of solubility of the alkali metal salt, it is preferable to use water, which is exemplified in the above together with the organic solvent, in combination. In the case where the above alkali metal salt is used as a hydrate in which crystal water is combined, the solubility is improved since a minute amount of water is contained derived from the crystal water but, since dissolution speed is enhanced by positively mixing water, the use of water is preferable from the viewpoint of workability.

[0053]

The above organic solvent is preferably liquid at the time of cleaning a mold and further, is particularly preferably one having no volatility at the time when the mold is heated. For example, polyhydric alcohols and polyhydric alcohol alkyl ethers are preferably used. Specifically, since a mold for semiconductor device molding in which a thermosetting resin composition is used as an encapsulating material is used at a mold temperature thereof of generally around 180°C, a solvent having a boiling point

of 180°C or higher is preferably used as a solvent to be used in such a case. Examples of the solvent having a boiling point of 180°C or higher include ethylene glycol monobutyl ether (boiling point: 188°C), propylene glycol (boiling point: 187°C), dipropylene glycol methyl ether (boiling point: 190°C), and diethylene glycol monomethyl ether (boiling point: 194°C).

[0054]

The mixing amount of the above organic solvent (total amount of the whole in the case where respective solvents are used in combination) is set to a range of preferably 3 to 30 parts, particularly preferably 5 to 20 parts with respect to 100 parts of the at least one of the synthetic rubber and the synthetic resin which serves as a base material. Namely, when the mixing amount is too small, the removing property of the contaminants formed on the mold surface remarkably decreases and complete removal of the mold contamination tends to be difficult. Contrarily, when the amount is too large, the cleaning effect is not improved and a labor for mixing increases and tends to be fruitless.

[0055]

Into the mold cleaning composition of the invention, a release agent, a reinforcing agent, and the like can be appropriately mixed according to need, in addition to the above respective mixing components as essential components.

[0056]

Examples of the release agent include long-chain aliphatic acids such as stearic acid and behenic acid; metal salts of long-chain aliphatic acids, such as zinc stearate and calcium stearate; ester waxes such as carnauba wax, montanic acid wax, and partially saponified esters of montanic acid; long-chain aliphatic acid amides such as stearylethylenediamide; and paraffins such as polyethylene wax. They may be used singly or two or more thereof are used in combination.

[0057]

A content of the release agent is set to a range of preferably 5 to 20 parts, more preferably 8 to 16 parts with respect to 100 parts of at least one of the synthetic rubber and the synthetic resin which serves as a base material. Namely, when the
5 content of the release agent is too small, it is difficult to obtain a sufficient releasing effect. Contrarily, when the content thereof is too large, the cleaning power is decreased and also there is a tendency that the appearance of the molded articles becomes worse at the time of producing a molded article using the mold after renewing.

[0058]

10 Examples of the reinforcing agent include inorganic fillers such as silica powder, talc powder, alumina, calcium carbonate, aluminum hydroxide, and titanium oxide. They may be used singly or two or more thereof may be used in combination. As the reinforcing agent, it is preferable to use one having an average particle size of about 0.01 to 100 μm .

15 [0059]

A content of the reinforcing agent is set to a range of preferably 10 to 50 parts, particularly preferably 15 to 40 parts with respect to 100 parts of at least one of the synthetic rubber and the synthetic resin which serves as a base material. Namely, when the content thereof is too small, there is a tendency that a decrease in mechanical
20 strength is invited owing to a decrease in reinforcing ability. Contrarily, when the content thereof is too large, the composition becomes brittle and there is also a tendency of a decrease in mechanical strength.

[0060]

Furthermore, into the mold cleaning composition of the invention, a
25 softening agent such as aroma oil or naphthenic oil, a vulcanizing agent such as sulfur

and a vulcanization accelerator, an aging inhibitor, zinc flower, and the like can be appropriately mixed according to need, in addition to the above additives.

[0061]

The mold cleaning composition of the invention can be, for example,
5 produced as follows. Namely, the composition can be produced by mechanically kneading respective mixing components including the above respective essential components using Banbury mixer, a kneader, a roll mixer, an extruder, or the like.

[0062]

The thus produced mold cleaning composition of the invention is provided
10 to mold cleaning as a mold cleaning material formed into a powder shape, a tablet-like shape, a sheet-like shape, or a strip-like shape. The thickness of the sheet in the case of the use as the sheet-like shape is usually set to 3 to 10 mm.

[0063]

The mold cleaning composition of the invention is preferably set to be a
15 hypochromic color such as white or gray near to white. By setting as above, there are served effects that it becomes possible to easily confirm visually the contamination which has been removed from the mold and attached to the mold cleaning composition after mold cleaning and the situation of mold cleaning can be easily confirmed.

[0064]

20 At the time of using the mold cleaning material obtained from the mold cleaning composition of the invention, in the case where the base material is a synthetic rubber, it is generally preferable to use the composition after molding it into a sheet-like shape. Moreover, in the case where the base material is a synthetic resin, for example, it is preferable to use the thermosetting melamine resin after forming it into a powder
25 shape or a tablet-like shape.

[0065]

A method for cleaning a mold by using the mold cleaning composition of the invention formed into the sheet-like shape is performed with placing it in a mold for semiconductor device molding. For example, in the case where the base material is a synthetic rubber, the above-mentioned sheet is, as a matter of course, in an
5 unvulcanized state and it is placed in the mold and then heat vulcanized to cause contaminants to adhere to the sheet integrally. Subsequently, cleaning of the mold is performed by removing the vulcanized sheet from the mold.

[0066]

10 The mold cleaning method using the sheet-like mold cleaning composition in the case of the base material being a synthetic rubber will be described below in detail in the order of events.

[0067]

To start with, a sheet-like mold cleaning material including the mold
15 cleaning composition of the invention is prepared. Then, the sheet-like mold cleaning material is placed between an upper mold in which depressions are formed and a lower mold in which depressions are formed, and the upper mold and the lower mold are clamped to sandwich the sheet-like mold cleaning material, followed by compression molding. The sheet-like mold cleaning material is filled into a cavity which is formed
20 of the depression formed in the upper mold and the depression formed in the lower mold and brought into a pressure contact with the mold surface by the pressure for molding. In this state, the synthetic rubber (unvulcanized rubber) is heat vulcanized by the heat for molding to be a vulcanized rubber and, at that time, an oxidized degraded layer of a release agent and the like formed in the cavity are combined with the
25 vulcanized rubber. On this occasion, in some cases, burr around the cavity is also combined with the vulcanized rubber. Subsequently, the upper mold and the lower

mold are opened after a predetermined time period and the sheet-like mold cleaning material that has become the vulcanized rubber is peeled off from the upper and lower molds, thereby peeling off the oxidized degraded layer and the like (contaminants) combined with the sheet-like mold cleaning material from the surface of the upper and
5 lower molds. Thus, the mold cleaning is performed.

[0068]

The conditions for sandwiching the sheet-like mold cleaning material and performing compression molding and heating are appropriately set depending on the kind of the base material and the like. For example, in the case of the synthetic rubber,
10 the conditions are preferably set to a range of 160 to 190°C and 1 to 5 minutes and, in the case of using a thermosetting resin as the synthetic resin, the conditions are preferably set to a range of 160 to 190°C and 1 to 5 minutes.

[0069]

One example of molds for which the mold cleaning composition of the
15 invention is to be used is, for example, a mold for semiconductor device molding in which repetitive molding is performed by using a thermosetting resin composition.

[0070]

In the mold for semiconductor device molding, which is one example of molds for which the mold cleaning composition of the invention is used, examples of
20 the thermosetting resin composition to be used as a molding resin material include an epoxy resin composition containing an epoxy resin as a main component.

[0071]

As the thermosetting resin composition, usually, a curing agent and, if necessary, additives such as an inorganic filler and a curing accelerator are
25 appropriately mixed together with the epoxy resin serving as the main ingredient.

[0072]

Then, since the mold cleaned with the mold cleaning composition of the invention is free from contaminants and restored to a mold surface of an initial state, a release agent is usually coated on the mold surface before molding semiconductor packages using the thermosetting resin composition serving as the mold material. For example, in the case of molding a mold material containing a montanic acid wax as the release agent, it is preferable to coat the montanic acid wax. Also, in the case of molding a mold material containing a Carnauba wax as the release agent, it is preferable to coat the Carnauba wax. As a method for coating the release agent on the mold surface, it is preferable to use an unvulcanized rubber composition containing the release agent, which is once prepared and then formed into a sheet-like shape. For example, there may be mentioned a sheet obtainable by mixing the release agent with the unvulcanized rubber described in the foregoing. The sheet formed of the unvulcanized rubber composition containing the release agent is mounted and heated in a mold in the same manner as in the cleaning process using the sheet-like mold cleaning composition, whereby the release agent contained therein is coated on the mold surface. It is considered that the release agent in the unvulcanized rubber composition is melted during the heat vulcanization and exuded out to the mold surface to form a uniform release agent film on the surface.

[0073]

A content of the above-mentioned release agent may be set to a ratio of preferably 15 to 35 parts, particularly preferably 20 to 30 parts with respect to 100 parts of the rubber material in the unvulcanized rubber composition. When the content of the release agent is less than 15 parts, a sufficient release effect is not exhibited. When the content thereof exceeds 35 parts, it is coated on the mold surface in an excessive

amount to cause deterioration in appearance of the molded article that is obtained by using the mold after the cleaning and renewing.

EXAMPLES

5 [0074]

The following will describe Examples together with Comparative Examples. However, the invention is not limited to these Examples.

[0075]

10 First, respective components constituting the mold cleaning composition were prepared.

[0076]

1) BR: [butadiene rubber: manufactured by JSR Corporation, BR-01 (cis-1,4 bond: 95%)]

15 2) EPR: [ethylene-propylene-diene rubber: manufactured by Mitsui Chemicals Inc., EPT 4045 (ethylene content: 54 mol%, diene component content: 8.1 mol%)]

3) Talc powder: average particle size 9 μm

4) Silica powder: average particle size 9 μm

5) Titanium oxide: average particle size 0.25 μm

20 6) Carnauba wax: Carnauba No.1 (manufactured by Nikko Rika Corporation)

7) Imidazole: 2,4-diamino-6-[2'-methylimidazolyl-(1')]ethyl-s-triazine

8) Organic peroxide: n-butyl-4,4-bis(t-butylperoxy)valerate

9) Water: ion-exchange water

25 10) PEG: polyethylene glycol (manufactured by NOF corporation, #200; weight-average molecular weight 200)

11) PG: propylene glycol (boiling point: 187°C)

12) DGMM: diethylene glycol monomethyl ether (boiling point: 194°C)

[0077]

Examples 1 to 8, Comparative Examples 1 to 2

5 Components shown in Tables 1 to 2 described below are mixed at the ratios shown in the tables, and each of the mixture was kneaded using a kneading roll. Then, the kneaded one is formed into a sheet-like shape (thickness of 5 mm) using a rolling roller to manufacture a desired sheet-like mold cleaning composition (mold cleaning material).

10 [0078]

Example 9

A powder-shape mold cleaning composition (mold cleaning material) was obtained by adhering 1 part of K_3PO_4 as a cleaning component and 4 parts of water by spraying to 100 parts of a product obtained by pulverizing a commercially available
15 thermosetting melamine resin for mold cleaning (manufactured by Nippon Carbide Industries Co., Inc., Nikalet ECR-T).

[0079]

Comparative Example 3

A tablet-like mold cleaning composition (mold cleaning material) is formed
20 using a commercially available thermosetting melamine resin for mold cleaning (manufactured by Nippon Carbide Industries Co., Inc., Nikalet ECR-T).

[0080]

A removing property of contaminants formed on a mold was evaluated using each of the thus obtained mold cleaning compositions (mold cleaning materials)
25 of Examples and Comparative Examples as follows. Namely, repetitive molding was performed using an environment-friendly epoxy resin (manufactured by Nitto Denko

Corporation, GE-7470) as an encapsulating material and, in the mold for molding whose surface had been contaminated after 800 shots, cleaning molding was performed using each of the mold cleaning compositions (mold cleaning materials) described above. Then, a molded article formed by cleaning molding was taken out from the mold and the removing property of the contaminants on the mold surface was visually evaluated. In the evaluation, the case where the number of the molding work capable of achieving complete removal of the contaminants is 5 times or less is evaluated as “good” and the case where 6 times or more of the molding work is required for the removal of the contaminants is evaluated as “poor”.

[0081]

In the evaluation of the products of Examples 1 to 8 and Comparative Examples 1 to 2, each of the sheet-like mold cleaning compositions (mold cleaning materials) was clamped with a mold for molding and heat molding was performed at 175°C for 5 minutes. On the other hand, transfer molding was performed using the powder-shape mold cleaning composition (mold cleaning material) in the evaluation of the sample of Example 9, and the tablet-like mold cleaning composition (mold cleaning material) in the evaluation of the sample of Comparative Example 3, followed by heat molding at 175°C for 3 minutes.

[0082]

The results of the above evaluation are shown in Tables 1 and 2 described below.

[0083]

Table 1 (part)

	Example								
	1	2	3	4	5	6	7	8	9
BR	50	70	50	70	50	50	50	50	-
EPR	50	30	50	30	50	50	50	50	-
Talc powder	-	-	-	55	55	-	-	-	-
Silica powder	40	40	40	-	-	40	-	40	-
Titanium oxide	5	5	5	5	5	-	-	5	-
Carnauba wax	-	-	-	-	-	-	10	-	-
Imidazole	-	-	-	-	-	10	-	-	-
Organic peroxide	2	2	2	2	2	2	2	2	-
Thermosetting melamine resin	-	-	-	-	-	-	-	-	100
$K_3PO_4 \cdot nH_2O$	2	-	-	-	-	-	-	2	1
$Na_3PO_4 \cdot 12H_2O$	-	2	-	-	-	2	2	-	-
KCOOH	-	-	10	-	-	-	-	-	-
KOH	-	-	-	0.2	-	-	-	-	-
NaOH	-	-	-	-	0.2	-	-	-	-
Water	5	10	15	15	10	10	10	30	4
Cleaning property	Good	Good	Good	Good	Good	Good	Good	Good	Good

[0084]

5

Table 2 (part)

	Comparative Example		
	1	2	3
BR	50	70	-
EPR	50	30	-
Talc powder	-	-	-
Silica powder	40	30	-
Titanium oxide	-	-	-
Carnauba wax	-	10	-
Imidazole	10	10	-
Organic peroxide	2	2	-
Thermosetting melamine resin	-	-	100
$K_3PO_4 \cdot nH_2O$	-	-	-
$Na_3PO_4 \cdot 12H_2O$	-	-	-
KCOOH	-	-	-
KOH	-	-	-
NaOH	-	-	-
Water	15	15	-
Cleaning property	Poor	Poor	Poor

[0085]

From the above results, the cleaning property on the mold is evaluated as “poor” in the samples of Comparative Examples that are not the cases of containing both of at least one of an alkali metal salt and an alkali metal hydroxide as a cleaning component and water, while an evaluation of “good” was obtained in all samples of Examples with regard to the cleaning property on the mold.

[0086]

Change of Encapsulating Material (1)

Further, against a mold for molding in which molding was performed repeatedly (after 800 shots) in the same manner as above using an environment-friendly epoxy resin: GE-1030 also manufactured by Nitto Denko Corporation instead of the environment-friendly epoxy resin (manufactured by Nitto Denko Corporation, GE-7470) as the encapsulating material, a removing property of contaminants formed on the mold was visually evaluated in the same manner as above using each of the mold cleaning compositions (mold cleaning materials) of Examples 1 to 9 and Comparative Examples 1 to 3. As a result, the cleaning property on the mold was evaluated as “poor” in the case of the samples of Comparative Examples, while an evaluation of “good” was obtained in all samples of Examples with regard to the cleaning property on the mold, as described in the above.

[0087]

Change of Encapsulating Material (2)

Moreover, against a mold for molding in which molding was performed repeatedly (after 800 shots) in the same manner as above using an environment-friendly epoxy resin: GE-100 also manufactured by Nitto Denko Corporation instead of the environment-friendly epoxy resin (manufactured by Nitto Denko Corporation, GE-7470) as the encapsulating material, a removing property of contaminants formed on the

mold was visually evaluated in the same manner as above using each of the mold cleaning compositions (mold cleaning materials) of Examples 1 to 9 and Comparative Examples 1 to 3. As a result, the cleaning property of the mold was evaluated as “poor” in the case of the samples of Comparative Examples, while an evaluation of “good” was obtained in all samples of Examples with regard to the cleaning property on the mold, as described in the above.

[0088]

Examples 10 to 18, Comparative Examples 4 and 5

Components shown in Tables 3 to 4 described below are mixed at the ratios shown in the tables, and each of the mixture was kneaded using a kneading roll. Then, the kneaded one is formed into a sheet-like shape (thickness of 5 mm) using a rolling roller to manufacture a desired sheet-like mold cleaning composition (mold cleaning material).

[0089]

Example 19

A powder-shape mold cleaning composition (mold cleaning material) was obtained by adhering 1 part of K_3PO_4 as a cleaning agent component, 3 parts of PEG as an organic solvent, and 1 part of water by spraying to 100 parts of a product obtained by pulverizing a commercially available thermosetting melamine resin for mold cleaning (manufactured by Nippon Carbide Industries Co., Inc., Nikalet ECR-T).

[0090]

Comparative Example 6 (* the same as Comparative Example 3 described above)

A tablet-like mold cleaning composition (mold cleaning material) was formed using a commercially available thermosetting melamine resin for mold cleaning (manufactured by Nippon Carbide Industries Co., Inc., Nikalet ECR-T).

[0091]

A removing property of contaminants formed on a mold was evaluated using each of the thus obtained mold cleaning compositions (mold cleaning materials) of Examples and Comparative Examples as follows. Namely, repetitive molding was performed using an environment-friendly epoxy resin (manufactured by Nitto Denko Corporation, GE-7470) as an encapsulating material and, in the mold for molding whose surface had been contaminated after 800 shots, cleaning molding was performed using each of the mold cleaning compositions (mold cleaning materials) described above. Then, a molded article formed by cleaning molding was taken out from the mold and the removing property of the contaminants on the mold surface was visually evaluated. In the evaluation, the case where the number of the molding work capable of achieving complete removal of the contaminants is 3 times or less is evaluated as good and the case where 4 times or more of the molding work is required for the removal of the contaminants is evaluated as poor.

[0092]

In the evaluation of the samples of Examples 10 to 18 and Comparative Examples 4 and 5, each of the sheet-like mold cleaning compositions (mold cleaning materials) was sandwiched in a mold for molding and heat molding was performed at 175°C for 5 minutes. On the other hand, transfer molding was performed using the powder-shape mold cleaning composition (mold cleaning material) in the evaluation of the sample of Example 19, and the tablet-like mold cleaning composition (mold cleaning material) in the evaluation of the sample of Comparative Example 6, followed by heat molding at 175°C for 3 minutes.

[0093]

The results of the above evaluation are shown in Tables 3 and 4 described below.

[0094]

Table 3 (part)

	Example									
	10	11	12	13	14	15	16	17	18	19
BR	50	70	50	70	50	50	50	50	50	-
EPR	50	30	50	30	50	50	50	50	50	-
Talc powder	-	-	-	55	55	-	-	-	-	-
Silica powder	40	40	40	-	-	40	-	40	40	-
Titanium oxide	5	5	5	5	5	-	-	5	5	-
Carnauba wax	-	-	-	-	-	-	10	-	-	-
Imidazole	-	-	-	-	-	10	-	-	-	-
Organic peroxide	2	2	2	2	2	2	2	2	2	-
Thermosetting melamine resin	-	-	-	-	-	-	-	-	-	100
$K_3PO_4 \cdot nH_2O$	2	-	-	-	-	-	-	5	-	1
$Na_3PO_4 \cdot 12H_2O$	-	2	-	-	-	2	2	-	5	-
KCOOH	-	-	10	-	-	-	-	-	-	-
KOH	-	-	-	0.2	-	-	-	-	-	-
NaOH	-	-	-	-	0.2	-	-	-	-	-
Water	-	5	5	10	5	2	2	5	5	1
PEG	-	-	10	-	-	-	-	-	-	3
PG	-	5	-	-	-	8	-	20	-	-
DGMM	5	-	-	5	5	-	8	-	25	-
Cleaning property	Good*	Good	Good	Good	Good	Good	Good	Good	Good	Good

* A cleaning property was good but it required a little time for homogenizing the composition since water was not mixed.

[0095]

Table 4 (part)

	Comparative Example		
	4	5	6
BR	50	70	-
EPR	50	30	-
Talc powder	-	-	-
Silica powder	40	30	-
Titanium oxide	-	-	-
Carnauba wax	-	10	-
Imidazole	10	10	-
Organic peroxide	2	2	-
Thermosetting melamine resin	-	-	100
$K_3PO_4 \cdot nH_2O$	-	-	-
$Na_3PO_4 \cdot 12H_2O$	-	-	-
KCOOH	-	-	-
KOH	-	-	-
NaOH	-	-	-
Water	15	15	-
PEG	-	-	-
PG	-	-	-
DGMM	-	-	5
Cleaning property	Poor	Poor	Poor

[0096]

- 5 From the above results, the cleaning property on the mold is evaluated as “poor” in Comparative Examples in which at least one of an alkali metal salt and an alkali metal hydroxide as a cleaning component was not contained, while an evaluation of “good” was obtained in all samples of Examples containing a base material; at least one of an alkali metal salt and an alkali metal hydroxide; and an organic solvent or an
- 10 organic solvent and water, with regard to the cleaning property of the mold.

[0097]

Change of Encapsulating Material (1)

Further, against a mold for molding in which molding was performed repeatedly (after 800 shots) in the same manner as above using an environment-friendly

epoxy resin: GE-1030 also manufactured by Nitto Denko Corporation instead of the environment-friendly epoxy resin (manufactured by Nitto Denko Corporation, GE-7470) as the encapsulating material, a removing property of contaminants formed on the mold was visually evaluated in the same manner as above using each of the mold cleaning compositions (mold cleaning materials) of Examples 10 to 19 and Comparative Examples 4 to 6. As a result, the cleaning property on the mold was evaluated as “poor” in the case of the samples of Comparative Examples, while an evaluation of “good” was obtained in all samples of Examples with regard to the cleaning property on the mold, as described in the above.

[0098]

Change of Encapsulating Material (2)

Moreover, against a mold for molding in which molding was performed repeatedly (after 800 shots) in the same manner as above using an environment-friendly epoxy resin: GE-100 also manufactured by Nitto Denko Corporation instead of the environment-friendly epoxy resin (manufactured by Nitto Denko Corporation, GE-7470) as the encapsulating material, a removing property of contaminants formed on the mold was visually evaluated in the same manner as above using each of the mold cleaning compositions (mold cleaning materials) of Examples 10 to 19 and Comparative Examples 4 to 6. As a result, the cleaning property on the mold was evaluated as “poor” in the case of the samples of Comparative Examples, while an evaluation of “good” was obtained in all samples of Examples with regard to the cleaning property on the mold, as described in the above.

[0099]

While the invention has been described in detail with reference to specific embodiments thereof, it will be apparent to one skilled in the art that various changes

and modifications can be made therein without departing from the spirit and scope thereof.

Incidentally, the present application is based on Japanese Patent Applications No. 2009-169330 filed on July 17, 2009 and No. 2009-169331 filed on
5 July 17, 2009, and the contents are incorporated herein by reference.

[0100]

The mold cleaning composition of the invention is used for cleaning, renewing, and the like of various molding molds for a thermosetting resin molding material, e.g., molds for molding to be used at the time of molding semiconductor
10 elements through repetitive resin encapsulation by injection molding or transfer molding using an epoxy resin molding material.

WHAT IS CLAIMED IS:

1. A mold cleaning composition for heat molding in which molding is repeatedly performed using a molding material, comprising:

at least one of a synthetic rubber and a synthetic resin which serves as a base material;

at least one of an alkali metal salt and an alkali metal hydroxide; and

at least one of water and an organic solvent.

2. The mold cleaning composition according to claim 1, wherein the synthetic rubber is at least one of ethylene-propylene rubber and butadiene rubber.

3. The mold cleaning composition according to claim 1, wherein the at least one of an alkali metal salt and an alkali metal hydroxide is contained in an amount of 0.1 to 10 parts by weight with respect to 100 parts by weight of the at least one of the synthetic rubber and the synthetic resin which serves as a base material.

4. The mold cleaning composition according to claim 1, wherein water is contained in an amount of 3 to 30 parts by weight with respect to 100 parts by weight of the at least one of the synthetic rubber and the synthetic resin which serves as a base material.

5. The mold cleaning composition according to claim 1, wherein the organic solvent is at least one selected from the group consisting of polyhydric alcohols and polyhydric alcohol alkyl ethers.

6. The mold cleaning composition according to claim 1 or 5, wherein the organic solvent is contained in an amount of 3 to 30 parts by weight with respect to 100 parts by weight of the at least one of the synthetic rubber and the synthetic resin which serves as a base material.

7. A mold cleaning material formed into a sheet-like shape using the mold cleaning composition according to any one of claims 1 to 6.

8. A method for cleaning a mold, said method comprising:

a step of placing a mold cleaning material comprising the mold cleaning composition according to any one of claims 1 to 6 on a mold plane of an opened mold;

a step of combining contaminants formed on a surface of the mold with the mold cleaning material by clamping the mold to sandwich the mold cleaning material, followed by heating and pressurizing; and

a step of cleaning the surface of the mold by peeling off the mold cleaning material combined with the contaminants from the mold.

9. The method of cleaning a mold according to claim 8, wherein the mold cleaning material is one obtained by forming the mold cleaning composition into a sheet-like shape.