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(54) Title: SILICONE RUBBER COMPOSITION FOR AIRBAG COATING

(57) Abstract: A silicone composition for a coating on a base cloth used for an airbag of an automobile and the like is provided. Since the cured product of the silicone composition is excellent in elongation, an intended internal pressure can be retained after the actuation of an airbag, and the cured film having excellent adhesiveness to a polyamide base cloth and a polyester base cloth can be formed even under high temperature and high humidity. Thus, there is provided an airbag which is highly safe as an airbag such as a curtain airbag. The silicone rubber composition for an airbag coating includes: (A) 100 parts by mass of a diorganopolysiloxane that contains two or more silicon atom-bonded alkenyl groups in one molecule and has a viscosity at 25°C of 100 to 500,000 mPa·s; (B-1) an organohydrogenpolysiloxane that contains one or more silicon atom-bonded hydrogen atoms in one molecule at a portion other than both terminals of the molecular chain, and 0 or more hydrogen atoms at both terminals of the molecular chain, and has a viscosity at 25°C of 1 to 2, 000 mPa·s; (B-2) a linear organohydrogenpolysiloxane that contains a silicon atom-bonded hydrogen atom only at both terminals of the molecular chain, and has a viscosity at 25°C of 1 to 2,000 mPa·s; (C) a micronized silica having a specific surface area by the BET method of 50 m^2/g or more; (D) an addition reaction catalyst; (E) an organosilicon compound having an epoxy group and a silicon atom-bonded alkoxy group in one molecule; and (F) a silane that contains one silanol group in one molecule or a siloxane compound with 2 to 4 silicon atoms.

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DESCRIPTION

SILICONE RUBBER COMPOSITION FOR AIRBAG COATING

TECHNICAL FIELD

[0001]

The present invention relates to a silicone composition for a coating on a base cloth used for an airbag of an automobile and the like. In particular, the present invention relates to a silicone rubber composition for a coating, which is excellent in elongation and is capable of forming a silicone cured film which is excellent in adhesiveness to base cloths, and thus can provide an airbag which is useful as an airbag such as a curtain airbag.

BACKGROUND ART

[0002]

In recent years, the safety during an automobile collision is demanded to be improved. Under such circumstances, an airbag apparatus which deploys and is inflated during a collision for protecting a passenger is increasingly mounted. This airbag apparatus includes a sensor that senses a strong shock caused by a collision, an inflator that generates gas, and an airbag that is inflated with the gas generated from the inflator. As a base cloth for the airbag, a woven cloth made of synthetic fibers such as polyamide and polyester is used. However, an untreated woven cloth does not satisfy strict requirements in terms of airtightness, heat resistance, and flame retardance against the high-pressure and high-temperature gas generated from the inflator. Therefore, there is generally used a product obtained by coating the base cloth with a silicone composition and curing the coating of the silicone composition.

[0003]

Meanwhile, the use object of airbags is expanding from the viewpoint of safety, and various airbags are mounted. There are mounted not only a known airbag which is actuated on the front of a passenger at a driver seat or a front passenger seat, but also, for example, an airbag called a side curtain airbag which is actuated on the side of a passenger. The side curtain airbag is housed along a portion from the front pillar to the roof side for the purposes of protecting the head of a passenger and preventing a passenger from being thrown from a car when a vehicle is overturned during a collision. The side curtain airbag is required to retain the state of deploying and being inflated for a certain time after actuated during a collision, unlike the airbag mounted at a driver seat or a front passenger seat.

[0004]

To cope with the retention of the deployment and inflation of the side curtain airbag, for example, Patent Literature 1 discloses a method of employing, for a silicone composition, an organohydrogenpolysiloxane that has a silicon atom-bonded hydrogen atom only at both terminals of the molecular chain. In this method, the ratio of the number of silicon atom-bonded hydrogen atoms only at both terminals of the molecular chain is increased to 30 to 60% of the number of all hydrogen atoms, thereby increasing the length of the molecular chain of the organopolysiloxane having an alkenyl group, which is a base compound, through a curing reaction. As a result, a gas leak after the deployment and inflation of an airbag is suppressed.

[0005]

However, the above-described silicone rubber composition had a problem as follows. As the ratio of the silicon atom-bonded hydrogen atoms only at both terminals of the molecular chain becomes higher, the length of the molecular chain increases thereby to enhance the elongation during the cutting of the cured product. On the other hand, the ratio of hydrogen atoms other than those at both terminals of the molecular chain, which are involved in the adhesion to a base cloth, drastically decreases. As a result, the adhesiveness to a base cloth significantly deteriorates. Since woven fabrics made of synthetic fibers such as polyamide and polyester deteriorate when exposed to heat, oxygen, and humidity for an extended time, the adhesiveness significantly decreases when a silicone-coated cloth is retained particularly under the environment of 80°C or higher in temperature and 95% or more in relative humidity for 500 hours or more. When explosives of the inflator which have deteriorated under high temperature and high humidity cause the generation of gas from the inflator with unexpected high pressure, this problem has the risk of becoming more serious.

CITATION LIST

PATENT LITERATURE

[0006]

Patent Literature 1: Japanese Patent Application Laid-Open No. 2006-241438

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0007]

The present invention has been made in view of the above-described circumstances, and relates to a silicone composition for a coating on a base cloth used for an airbag of an automobile and the like. An object of the present invention is to provide an airbag which is highly safe as an airbag such as a curtain airbag, a silicone composition for an airbag coating, and an airbag base cloth, in which the cured product of the silicon composition is excellent in elongation thereby to retain an intended internal pressure after the actuation of the airbag, and the cured film having excellent adhesiveness to a polyamide base cloth and a polyester base cloth can be formed even under high temperature and high humidity.

SOLUTION TO PROBLEM

[0008]

The present inventors have intensively conducted studies. As a result, they have found an formulation of a silicone rubber composition for an airbag coating, in which an organohydrogenpolysiloxane containing a silicone atom-bonded hydrogen atom only at both terminals of the molecular chain is included at a prescribed ratio to enhance the elongation of the cured product, and the cured film having excellent adhesiveness to a polyamide base cloth and a polyester base cloth can be formed even when an airbag is retained under the environment of 80°C in temperature and 95% in relative humidity for 500 hours. Thus, the present invention has been accomplished.

[0009]

That is, the present invention is a silicone rubber composition for an airbag coating including: (A) 100 parts by mass of a diorganopolysiloxane that contains two or more silicon atom-bonded alkenyl groups in one molecule and has a viscosity at 25°C of 100 to 500,000 mPa·s; (B-1) an organohydrogenpolysiloxane that contains one or more silicon atom-bonded hydrogen atoms in one molecule at a portion other than both terminals of the molecular chain thereof, and 0 or more hydrogen atoms at both terminals of the molecular chain thereof, and has a viscosity at 25°C of 1 to 2,000 mPa·s; (B-2) a linear organohydrogenpolysiloxane that contains a silicon atom-bonded hydrogen atom only at both terminals of the molecular chain thereof, and has a viscosity at 25°C of 1 to 2,000 mPa·s; (C) a micronized silica having a specific surface area by a BET method of 50 m^2/g or more; (D) an addition reaction catalyst; (E) an organosilicon compound having an epoxy group and a silicon atom-bonded alkoxy group in one molecule; and (F) a silane that contains one silanol group in one molecule or a siloxane compound with 2 to 4 silicon atoms. The present invention is also an airbag base cloth formed from the cured product of the composition, and an airbag formed from the base cloth. The silicone composition is excellent in elongation, and can form a silicone cured film which is excellent in adhesiveness to the base cloth.

[0010]

The silicone rubber composition for an airbag coating may preferably include 0.05 to 10 parts by mass of (G) a component having a function of improving adhesiveness of the silicone composition. Furthermore, the component (G) may be preferably one or more organometallic compounds selected from the group consisting of an organic titanium compound, an organic zirconia compound, and an organic aluminum compound.

[0011]

In the silicone rubber composition for an airbag coating, the organohydrogenpolysiloxane (B-1) may preferably include a compound represented by general formula (1) below:

$$HR^1_2SiO-(HR^1SiO)_m-(R^1_2SiO)_n-SiR^1_2H \quad (1)$$

(wherein R^1s are the same as or different from each other, and each an unsubstituted or halogen-substituted monovalent hydrocarbon group having 1 to 10 carbon atoms which independently does not have an unsaturated aliphatic bond, m is a positive number of 1 to 50, n is a positive number of 0 to 150, and t represented by formula: $t = m/(m + n)$ satisfies $0.01 \leq t \leq 1.0$).

[0012]

In the silicone rubber composition for an airbag coating, the organohydrogenpolysiloxane (B-1) may preferably have a trimetylsiloxy group at both terminals of the molecular chain, and contain at least one aromatic group bonded to a silicon atom in the molecule.

ADVANTAGEOUS EFFECTS OF INVENTION

[0013]

The silicone rubber composition for an airbag coating according to the present invention has an elongation of 800% or more when the cured product thereof is cut. Therefore, an intended internal pressure can be retained even after the deployment and inflation of the airbag. Furthermore, since adhesiveness to the base cloth is excellent even under the high-temperature and high-humidity environment, the airbag is normally actuated even when an inflator generates gas under an unexpected high pressure caused by deteriorated explosives of the inflator at high temperature and high humidity. Accordingly, there can be obtained an airbag which is highly safe as an airbag such as a curtain airbag.

DESCRIPTION OF EMBODIMENTS

[0014]

Hereinafter, the silicone rubber composition for an airbag coating according to the present invention will be described in detail.

[0015]

(Component (A))

A component (A) is a diorganopolysiloxane having two or more silicon atom-bonded alkenyl groups in one molecule, and is a base compound of a silicone rubber composition having excellent rubber physical properties after cured. The component (A) usually has an average composition formula represented by general formula (2) below:

$$R^1_aSiO_{(4-a)/2} \quad (2)$$

(wherein R^1s are the same as or different from each other, and each an unsubstituted or substituted monovalent hydrocarbon group having 1 to 18 carbon atoms, and a is 1.7 to 2.1).

[0016]

Here, at least two of the monovalent hydrocarbon groups represented by R_1 are selected from an alkenyl group such as a vinyl group, an allyl group, a propenyl group, an isopropenyl group, a butenyl group, an isobutenyl group, a hexenyl group, and a cyclohexenyl group. The other of the monovalent hydrocarbon groups represented by R_1 is a substituted or unsubstituted monovalent hydrocarbon group having 1 to 18 carbon atoms. Specific examples thereof may include: an alkyl group such as a methyl group, an ethyl group, a propyl group, an isopropyl group, a butyl group, an isobutyl group, a tert-butyl group, a pentyl group, a neopentyl group, a hexyl group, a 2-ethylhexyl group, a heptyl group, an octyl group, a nonyl group, a decyl group, and a dodecyl group; a cycloalkyl group such as a cyclopentyl group, a cyclohexyl group, and a cycloheptyl group; an aryl group such as a phenyl group, a tolyl group, a xylyl group, a biphenyl group, and a naphthyl group; an aralkyl group such as a benzyl group, a phenylethyl group, a phenylpropyl group, and a methylbenzyl group; and a halogen-substituted alkyl group and a cyano-substituted alkyl in which a part of or the entire of hydrogen atoms in the aforementioned hydrocarbon groups is substituted with a halogen atom, a cyano group, or the like, such as a chloromethyl group, a 2-bromoethyl group, a 3,3,3-trifluoropropyl group, a 3-chloropropyl group, and a cyanoethyl group.

[0017]

In the selection of R_1s, the required two or more alkenyl groups are preferably a vinyl group, and other groups are preferably a methyl group, a phenyl group, and a 3,3,3-trifluoropropyl group. Also, preferably 70 mol% or more, usually 80 mol% or more, of all R_1s is a methyl group, in terms of physical properties of the cured product and economic efficiency.

[0018]

The diorganopolysiloxane of the component (A) may be linear or branched. Examples of the molecular structure may include: a dimethylpolysiloxane in which both terminals of the molecular chain are blocked with a dimethylvinylsiloxy group; a dimethylsiloxane·methylphenylsiloxane copolymer in which both terminals of the molecular chain are blocked with a dimethylvinylsiloxy group; a dimethylsiloxane·methylvinylsiloxane copolymer in which both terminals of the molecular chain are blocked with a dimethylvinylsiloxy group; a dimethylsiloxane·methylvinylsiloxane·methylphenylsiloxane copolymer in which both terminals of the molecular chain are blocked with a dimethylvinylsiloxy group; a dimethylsiloxane·methylvinylsiloxane copolymer in which both terminals of the molecular chain are blocked with a trimethylsiloxy group; an organopolysiloxane including a siloxane unit represented by formula: $(CH_3)_2ViSiO_{1/2}$, a siloxane unit represented by formula: $(CH_3)_3SiO_{1/2}$, and a siloxane unit represented by formula: $SiO_{4/2}$ [in the formulae, Vi represents a vinyl group]; an organopolysiloxane in which a part of or the entire of methyl groups of each of these organopolysiloxanes is substituted with an alkyl group such as an ethyl group and a propyl group, an aryl group such as a phenyl group and a tolyl group, and an alkyl halide group such as a 3,3,3-trifluoropropyl group; and a mixture of two or more of these organopolysiloxanes. However, a linear diorganopolysiloxane having a vinyl group at both terminals of the molecular chain is preferable for increasing the length of the molecular chain to enhance the elongation when the cured product is cut.

[0019]

These diorganopolysiloxanes are manufactured by a method known to those skilled in the art. The viscosity at 25°C of the diorganopolysiloxane of The component (A) to be used is 100 to 500,000 mPa·s, and preferably 1,000 to 500,000 mPa·s. Two or more diorganopolysiloxanes having different viscosities are particularly preferably used so that the final viscosity of the silicone composition is easily adjusted.

[0020]

(Component (B-1))

A component (B-1) is a component that causes the cured product of the silicone composition to crosslink and contributes to favorable adhesion to a base cloth. The component (B-1) is an organohydrogenpolysiloxane that contains one or more silicon atom-bonded hydrogen atoms in one molecule, and is any organohydrogenpolysiloxane other than an organohydrogenpolysiloxane that has a silicon atom-bonded hydrogen atom only at both terminals of the molecular chain. Examples thereof to be used may include methylhydrogenpolysiloxane, a dimethylsiloxane·methylhydrogensiloxane copolymer, a methylphenylsiloxane·methylhydrogensiloxane copolymer, cyclic methylhydrogenpolysiloxane, and a copolymer including a dimethylhydrogensiloxy unit and an $SiO_{4/2}$ unit.

[0021]

From the viewpoint of a synergistic effect of providing adhesiveness and effectively enhancing elongation, the component (B-1) is preferably an organohydrogenpolysiloxane that has a silicon atom-bonded hydrogen atom at both terminals of the molecular chain and also contains at least one silicon atom-bonded hydrogen atom in the molecular chain in the molecule. Specifically, it is preferable to contain a linear organohydrogenpolysiloxane represented by general formula (1) below:

$$HR^1_2SiO-(HR^1SiO)_m-(R^1_2SiO)_n-SiR^1_2H \quad (1)$$

wherein R^1s are the same as or different from each other, and each an unsubstituted or halogen-substituted monovalent hydrocarbon group having 1 to 10 carbon atoms which independently does not have an unsaturated aliphatic bond, m is a positive number of 1 to 50, n is 0 or a positive number of 1 to 150, and t represented by formula: $t = m/(m + n)$ satisfies $0.01 \leq t \leq 1.0$. In the formula (1), m is more preferably 1 to 20, n is more preferably 10 to 100, and t is $0.02 \leq t \leq 1.0$, and further preferably $0.02 \leq t \leq 0.2$. When m becomes 50 or more, elongation at break is not enhanced. When n is 150 or more, the hardness of the cured product decreases. Also, when t is less than 0.01, an addition effect is not obtained, and when it is more than 0.1, elongation at break is not enhanced.

[0022]

Also, from the viewpoint of the improvement of adhesiveness and heat resistance, the component (B-1) to be used is preferably an organohydrogenpolysiloxane that has a trimethylsiloxy group at both terminals in the molecular chain and at least one aromatic group in the molecule. The aromatic group is preferably a phenyl group for economic reasons.

[0023]

The viscosity at 25°C of the organohydrogenpolysiloxane of the component (B-1) is 1 to 2,000 mPa·s, and preferably 2 to 1,000 mPa·s. Also, one of the organohydrogenpolysiloxanes of the component (B-1) may be used alone, or two or more thereof may be used in combination.

[0024]

(Component (B-2))

A component (B-2) is a component that causes the cured product of the silicone composition to crosslink and contributes to enhanced elongation at break. The component (B-2) is any linear organohydrogenpolysiloxane which has a silicon atom-bonded hydrogen atom only at both terminals of the molecular chain. This enables the length of the molecular chain of the organopolysiloxane having an alkenyl group, which is a base compound, to be relatively easily increased by a curing reaction.

[0025]

The component (B-2) is preferably an organohydrogenpolysiloxane containing at least one aromatic group in the molecule, from the viewpoint of the improvement in heat resistance. The aromatic group is more preferably a phenyl group for economic reasons.

[0026]

The viscosity at 25℃ of the organohydrogenpolysiloxane of the component (B-2) is 1 to 2,000 mPa·s, and preferably 2 to 1,000 mPa·s. Also, one of the organohydrogenpolysiloxanes of the component (B-2) may be used alone, or two or more thereof may be used in combination. It is preferable to use a plurality of organohydrogenpolysiloxanes of the component (B-2), because the cured product is likely to have unevenly distributed crosslinking points thereby to relatively easily enhance the elongation of the cured product.

[0027]

The total number of hydrogen atoms in the component (B-1) and the component (B-2) is preferably 1/5 to 7/1 per one alkenyl group of the component (A). When the total number of hydrogen atoms is less than 1/5, hardness significantly decreases. When it is more than 7/1, hardness becomes excessive. Accordingly, the rubbing impact during an adhesion test is likely to cause cracks in the cured film. Also, the ratio of the total number of silicon atom-bonded hydrogen atoms contained in the component (B-2) relative to the total number of silicon atom-bonded hydrogen atoms contained in the component (B-1) and the component (B-2) is 10 to 60%, more preferably 15 to 45%, and further preferably 15 to 30%. When the ratio is less than 10%, desired elongation at break becomes difficult to obtain. On the other hand, when the ratio is more than 60%, the hardness of the cured product decreases to a large extent, and the cured film cannot withstand a load of the rubbing impact during an adhesion test thereby to peel.

[0028]

(Component (C))

Examples of silica of a component (C) may include fumed silica, silica fume, precipitated silica, pyrogenic silica, colloidal silica, and diatomaceous earth, which have hydrophilicity and hydrophobicity. In particular, these are preferably fine powder. The particle size and the specific surface area thereof are preferably 100 μm or less and 50 m^2/g or more, respectively. Also, the surface of the silica to be used may be previously treated with organosilane, organosilazane, organocyclopolysiloxane, or the like. The added amount of the component (C) relative to 100 parts by mass of the component (A) is usually 5 to 50 parts by mass, and preferably 10 to 30 parts by mass. One of these silicas may be used alone, or two or more thereof may be used in combination.

[0029]

When a hydrophilic micronized silica is used, it is preferable that the surface of the micronized silica be previously subjected to a hydrophobization treatment with a hydrophobization treatment agent as necessary. Examples of the hydrophobization treatment agent may include organosilazane such as hexamethyldisilazane, halogenated silane such as methyltrichlorosilane, dimethyldichlorosilane, and trimethylchlorosilane, organoalkoxysilane in which these halogen atoms are substituted with an alkoxy group such as a methoxy group and an ethoxy group, and dimethyl silicone oil. Among these, hexamethyldisilazane is preferable.

[0030]

(Component (D))

An addition reaction catalyst of a component (D) is a catalyst that promotes an addition curing reaction between an alkenyl group and a silicon atom-bonded hydrogen atom, and that is known to those skilled in the art. Examples of the addition reaction catalyst of the component (D) may include: platinum group metal such as platinum, rhodium, palladium, osmium, iridium, and ruthenium; a product obtained by fixing the platinum group metal to a particulate carrier material (for example, activated carbon, aluminum oxide, and silicon oxide); and a platinum compound such as platinum halide, a platinum-olefin complex, a platinum-alcohol complex, a platinum-alcoholate complex, a platinum-vinylsiloxane complex, dicyclopentadiene-platinum dichloride, cyclooctadiene-platinum dichloride, and cyclopentadiene-platinum dichloride.

[0031]

Also, from economic reasons, a metal compound catalyst other than noble metal may be used. For example, as a hydrosilylation iron catalyst, there are used an iron—carbonyl complex catalyst, an iron catalyst having a cyclopentadienyl group as a ligand, an iron catalyst having a terpyridine-based ligand or having a terpyridine-based ligand and a bistrimethylsilylmethyl group, an iron catalyst having a bisiminopyridine ligand, an iron catalyst having a bisiminoquinoline ligand, an iron catalyst having an aryl group as a ligand, an iron catalyst having a cyclic or non-cyclic olefin group having an unsaturated group, and an iron catalyst having a cyclic or non-cyclic olefinyl group having an unsaturated group. Other examples may include a hydrosilylation cobalt catalyst, a hydrosilylation vanadium catalyst, a hydrosilylation ruthenium catalyst, a hydrosilylation iridium catalyst, a hydrosilylation samarium catalyst, a hydrosilylation nickel catalyst, and a hydrosilylation manganese catalyst.

[0032]

The formulation amount of the addition reaction catalyst of the component (D) is an effective amount depending on the curing temperature and curing time intended in this use. Usually, the formulation amount relative to the total mass of the silicone rubber composition is, in terms of the concentration of a catalyst metal element, 0.5 to 1,000 ppm, preferably 1 to 500 ppm, and more preferably 1 to 100 ppm. When the formulation amount is less than 0.5 ppm, an addition reaction becomes significantly slow. On the other hand, when the formulation amount is more than 1,000 ppm, the cost is increased, and economic efficiency is unfavorable.

[0033]

(Component (E))

An organosilicon compound of a component (E) is any organosilicon compound which has an epoxy group and a silicon atom-bonded alkoxy group in one molecule. More preferably, the organosilicon compound of the component (E) has at least one epoxy group and at least two silicon atom-bonded alkoxy groups. Such an epoxy group is preferably bonded to a silicon atom in the form of a glycidoxyalkyl group such as a glycidoxypropyl group, and an epoxy-containing cyclohexylalkyl group such as a 2,3-epoxycyclohexylethyl group and a 3,4-epoxycyclohexylethyl group. Two or three epoxy groups may be contained in one molecule. Also, the silicon atom-bonded alkoxy group is preferably a methoxy group, an ethoxy group, and a propoxy group, as well as an alkyldialkoxysilyl group such as a methyldimethoxysilyl group, an ethyldimethoxysilyl group, a methyldiethoxysilyl group, and an ethyldiethoxysilyl group. Examples of a functional group other than the above-described groups may be a functional group selected from an alkenyl group such as a vinyl group, a (meth)acryloxy group, a hydrosilyl group (SiH group), and an isocyanate group.

[0034]

(Component (F))

A siloxane compound of a component (F) is a component that imparts the function to control the change in viscosity of the silicone composition in a time-dependent manner. The siloxane compound is a silane containing at least one silanol group (that is, a silicon atom-bonded hydroxyl group) in one molecule or a siloxane compound. One of these siloxane compounds may be used alone, or two or more thereof may be used in combination. The siloxane compound is an oligomer with usually 2 to 4 silicon atoms in the molecule.

[0035]

Examples of such a siloxane compound of the component (F) may include silane such as trimethylsilanol, triethylsilanol, triisopropylsilanol, triphenylsilanol, dimethylphenylsilanol, vinylphenylmethylsilanol, dimethylvinylsilanol, and oligomers thereof, as well as silanol-terminated polydimethylsiloxane, a silanol-terminated diphenylsiloxane-dimethylsiloxane copolymer, silanol-terminated polydiphenyl siloxane, silanol-terminated polytrifluoropropylmethylsiloxane, 1-hydroxyheptamethylcyclotetrasiloxane, and oligomers thereof. Among these, trimethylsilanol, triethylsilanol, triisopropylsilanol, and triphenylsilanol are preferable, in terms of availability and industrial handleability.

[0036]

The added amount of the component (F) relative to 100 parts by mass of the component (A) is usually 0.02 to 20 parts by mass, and preferably 0.1 to 10 parts by mass. When the added amount is less than 0.1 parts, the effect to control the viscosity of the silicone composition in a time-dependent manner is low. When it is more than 20 parts by mass, the curing rate becomes slow.

[0037]

(Component (G))

A component having the function of improving the adhesiveness of the silicone composition of a component (G) is not limited to a specific compound, and can be any compound which does not impair the object of the present invention. For example, a so-called silane coupling agent may be used. The organic functional group is preferably at least one of a vinyl group, a methacryl group, an acryl group, and an isocyanate group. Examples may include methacryloxysilane such as 3-methacryloxypropyltrimethoxysilane and 3-methacryloxypropyltriethoxysilane, and furandione such as 3-trimethoxysilylpropyl succinic acid anhydride and dihydro-3-(3-(triethoxysilyl)propyl)-2,5-furandione. The organic functional group may be bonded to a silicon atom via another group such as an alkylene group. This is preferable, because the use in combination with the component (E) promotes the effect. Other than such an organosilicon compound, there can be used an organometallic compound such as an organic titanium compound, an organic zirconium compound, and an organic aluminum compound. These organometallic compounds are not particularly limited as long as they serve as a condensation co-catalyst for promoting adhesion, and are further effectively used in combination with the above-described silane coupling agent. Particularly preferable examples of such a combination may include a combination of methacryloxy group-containing organoalkoxysilane and a titanium chelate compound and/or a zirconium chelate compound, a combination of dihydro-3-(3-(triethoxysilyl)propyl)-2,5-furandione and a titanium chelate compound and/or a zirconium chelate compound, and a combination of methacryloxy group-containing organoalkoxysilane, dihydro-3-(3-(triethoxysilyl)propyl)-2,5-furandione, and a titanium chelate compound and/or a zirconium chelate compound.

[0038]

Examples of such an organometallic compound may include an organic titanic acid ester such as tetraisopropyl titanate and tetrabutyl titanate; a titanium-based condensation co-catalyst such as an organic titanium chelate compound such as diisopropoxy(acetylacetonate) titanium, diisopropoxy(ethylacetoacetate) titanium, tetraacetylacetonate titanium, and tetraacetylacetate titanium; an organic zirconium ester such as zirconium tetrapropylate and zirconium tetrabutyrate;

an organic zirconium chelate such as zirconium tributoxyacetylacetonate, zirconium butoxyacetylacetonate bisethylacetoacetate, and zirconium tetraacetylacetonate; a zirconium-based condensation co-catalyst such as an oxozirconium compound such as zirconium bis(2-ethylhexanoate)oxide and zirconium acetylacetonate(2-ethylhexanoate)oxide; an aluminum alcholate such as aluminum triethylate, aluminum triisopropylate, and aluminum tri(sec-butyrate); an aluminum chelate compound such as diisopropoxyaluminum(ethylacetoacetate), aluminum tris(ethylacetoacetate), and aluminum tris(acetylacetonate); and an aluminum-based condensation catalyst such as an aluminum acyloxy compound such as hydroxyaluminum bis(2-ethylhexanoate).

[0039]

Also, an organic compound containing an isocyanate group in the molecule, for example, may be used other than the above-described organometallic compound. Such an organic compound is not particularly limited and can be any organic compound, as long as it contains at least one isocyanate group in one molecule. Examples of the organic compound containing an isocyanate group in the molecule may include benzyl isocyanate, tolylene diisocyanate, triallyl isocyanurate, trimethylhexamethylene diisocyanate, diphenylmethane diisocyanate, hexamethylene diisocyanate, butane diisocyanate, pentane diisocyanate, tetramethylene-1,4-diisocyanate, pentamethylene-1,5-diisocyanate, 2,2,4-trimethyl-hexamethylene-1,6-diisocyanate, lysine diisocyanate, isophorone diisocyanate, hydrogenated xylylene diisocyanate, hydrogenated diphenylmethane diisocyanate, 1,4-cyclohexane diisocyanate, 1,3-bis(isocyanatemethyl)-cyclohexane, 4,4-dicyclohexylmethane diisocyanate, tris(3-trimethoxysilylpropyl)isocyanurate, tris(3-triethoxysilylpropyl)isocyanurate, tris(3-propoxysilylpropyl)isocyanurate, and derivatives and precursors thereof. One of these organic compounds may be used alone, or two or more thereof may be used. The organic compound is preferably used in combination with the above-described silane coupling agent.

[0040]

The silicone composition according to the present invention can contain any additives known as additives to silicone rubber, as an optional component other than the above-described components (A) to (G), within the range that does not impair the object of the present invention. Examples of such additives may include a reinforcing filler, a non-reinforcing filler, an adhesion promoter, a pigment, a dye, a curing inhibitor, a heat resistance promoter, a flame retardant, an antistatic agent, a conductivity promoter, an airtightness improving agent, a radiation shielding agent, an electromagnetic wave shielding agent, a preservative, a stabilizer, an organic solvent, a plasticizer, a fungicide, an organopolysiloxane which contains one silicon atom-bonded hydrogen atom or alkenyl group in one molecule and which does not contain any other functional group, and a non-functional organopolysiloxane which does not contain a silicon atom-bonded hydrogen atom and alkenyl group. One of these additives may be formulated alone, or two or more thereof may be formulated in combination.

[0041]

Examples of the pigment may include titanium oxide, alumina silicate, iron oxide, zinc oxide, calcium carbonate, carbon black, rare earth oxides, chromium oxide, cobalt pigments, ultramarine blue, cerium silanolate, aluminum oxide, aluminum hydroxide, titanium yellow, carbon black, barium sulfate, precipitated barium sulfate, and mixtures thereof.

[0042]

The curing inhibitor has the ability to adjust the curing rate of an addition reaction. Examples thereof may include an acetylene-based compound, hydrazines, triazoles, phosphines, and mercaptans. Any curing inhibitor which is known as a compound having the curing suppression effect in the art can be used. Examples of such a compound may include a phosphorous-containing compound such as triphenylphosphine, a nitrogen-containing compound such as tributylamine, tetramethylethylenediamine, and benzotriazole, a sulfur-containing compound, an acetylene-based compound, a compound containing two or more alkenyl groups, a hydroperoxy compound, and a maleic acid derivative. Also, amino group-containing silane and an amino group-containing silicone compound may be used.

[0043]

Specific examples thereof may include various "ene-ine" systems such as 3-methyl-3-pentene-1-ine and 3,5-dimethyl-3-hexene-

1-ine; acetylene-based alcohol such as 3,5-dimethyl-1-hexyne-3-ol, 1-ethynyl-1-cyclohexanol, and 2-phenyl-3-butyne-2-ol; known dialkyl, dialkenyl, and maleate and fumarate such as dialkoxyalkyl fumarate and maleate; and a compound which contains cyclovinylsiloxane.

[0044]

Examples of the heat resistance promoter may include cerium hydroxide, cerium oxide, iron oxide, fume titanium dioxide, and mixtures thereof.

[0045]

The airtightness improving agent may be any agent which has the effect of reducing air permeability of the cured product, and can be an organic matter or an inorganic matter. Specific examples thereof may include urethane, polyvinyl alcohol, polyisobutylene, an isobutylene-isoprene copolymer, plate-like talc, mica, glass flakes, boehmite, various metal foils, powdered metal oxides, and mixtures thereof.

[0046]

The silicone composition for an airbag coating according to the present invention can be manufactured by a method known to those skilled in the art, and the method is not limited. Examples of such a known method may include a method including previously mixing the components (A), (B), and (C) or components (A), (C), and (D) using a stirrer, or uniformly kneading the components (A), (B), and (C) or components (A), (C), and (D) using a two-roll, a kneader mixer, a pressurized kneader mixer, a high shear-type mixer such as a Ross mixer, an extruder, a continuous extruder, or the like, to prepare a silicone rubber base, and thereafter adding the components (E), (F), (G) or the like to the obtained silicone rubber base thereby to produce a silicone composition. Another known example may include previously producing the components (A) and (B) or components (A) and (D) with an emulsifier in an emulsifying apparatus.

[0047]

Also, the silicone composition according to the present invention is preferably preserved in the form of at least two different components, so that curing does not previously proceed. For example, it is preferable that one of the components contain the organopolysiloxane (A) having an unsaturated bond, and the other contain the organohydrogenpolysiloxane (B) having a silicon atom-bonded hydrogen atom. Furthermore, corresponding co-agents and additives are preferably contained in one or both of the components. Moreover, for preserving the composition according to the present invention in the form of at least two different components, these different components may be preserved in an organic solvent such as toluene, xylene, hexane, white spirit, and mixtures thereof. Alternatively, these different components may be emulsified with an emulsifier so that they are preserved in an aqueous emulsion state. In particular, in order to prevent the risk of fire, the deterioration of working environments, and polluted air caused by the volatilization of an organic solvent, it is preferable to use no solvent and be in the state of an emulsion having been emulsified with an emulsifier,.

[0048]

The present invention relates to a silicone composition for a coating on a base cloth used for an airbag of an automobile and the like. An airbag is obtained by sewing an airbag base cloth into a bag shape. The airbag is mainly mounted for automobiles. The bag is to be inflated when an accident occurs, thereby to secure the safety of a driver and a passenger. The airbag base cloth is usually woven with a synthetic fiber such as polyamide and polyethylene terephthalate.

The coating composition according to the present invention is applied onto the synthetic fiber woven fabric for airbags. Specifically, there are used polyamide fiber woven fabrics such as nylon 6, nylon 66, and nylon 46, aramid fiber woven fabrics, polyester fiber woven fabrics represented by polyalkylene terephthalate, polyetherimide fiber woven fabrics, sulfone-based fiber woven fabrics, carbon fiber woven fabrics, and mixtures thereof. The coating composition according to the present invention is applied onto flat woven fabrics, bag-shaped woven fabrics, and hose-shaped woven fabrics depending on the type of an airbag, which include 10 to 5000 decitex threads. From the viewpoint of processability and economic efficiency, woven fabrics including 50 to 1000 decitex threads are preferable.

[0049]

When coating the base cloth with the coating agent according to the present invention is performed after the base cloth has been scoured, drying may be performed after the scouring treatment of the base cloth, and thereafter coating with the coating composition according to the present invention may be performed. Alternatively, coating with the coating composition according to the present invention may be performed before the drying after the scouring treatment, and thereafter drying may be performed such that the drying of the scouring liquid and the curing of the coating composition are simultaneously achieved. Also, the coating composition according to the present invention may be directly applied to the base cloth which is not subjected to a scouring treatment completely.

[0050]

The coating with the coating composition according to the present invention can be performed by a generally used method. Examples of such a method may include immersion and padding, brushing, flow coating, spraying, roller coating, gravure coating, comma coater, textile printing, knife coating, Meyer bar, air brush, slop padding, and roll coating. One or a combination of these methods is performed depending on circumstances. Also, when one coating method is performed, the coating is not necessarily performed once, and may be repeated multiple times until an intended coating state is obtained. Accordingly, the number of cured films after coating is not necessarily one, and may be two or more. Furthermore, for example, in order to prevent fouling or charging, impart sliding properties, or prevent blocking, an additional component may be formulated, or additional processing may be performed on the surface of the cured film after coating. Also, another cured film having such functions may be further formed.

[0051]

The drying and curing after coating is usually performed in a heating device which can generate heat with hot air, infrared rays, gas burners, heat exchangers, or other energy sources. It is noted that this drying and curing can be performed with not only commonly used heating devices but also any device having a drying ability to achieve intended drying and curing. Examples thereof may include a heating roll calendar, a heatable bonding press, a heatable daylight press, a high-temperature kiss roll, a hot air dryer, and a microwave dryer.

[0052]

It is preferable that a heating device have a plurality of temperature zones set during curing, in order to prevent the formation of bubbles in the cured film. For example, preliminary drying can be performed in a first temperature zone of 60 to 150℃, preferably 80 to 130℃, and further preferably 90 to 120℃, and curing can be performed in a subsequent second temperature zone of up to 300℃. However, since most fibers have heat resistance limitations, the temperature range of 120 to 250℃ is preferable.

[0053]

It is noted that even when a plurality of temperature zones is difficult to set in terms of the processes, it is preferable that preliminary drying be performed such that the temperature of a material to be cured reaches 170°C or higher at least once. Also, the retention time necessary for curing is preferably about 0.5 to 30 minutes, depending on the weight of coating, the heat conductivity of fabrics, and the heat conduction to coated fabrics. The above-described drying and curing may be performed by leaving the fabrics at room temperature for 10 minutes to several hours.

EXAMPLES

[0054]

Hereinafter, the present invention will be specifically described with reference to examples and comparative examples. However, the present invention is not limited to the following examples. It is noted that part or parts described in each example indicates part or parts by mass and viscosity is measured at 25°C.

[0055]

<Preparation Method of Rubber Base>

To 67.4 parts of commercially available dimethylpolysiloxane, as the component (A), which contained a vinyl group at both terminals and had a viscosity of approximately 20,000 mPa·s, added were 5.8 parts of dimethylpolysiloxane which contained a vinyl group at both terminals and had a viscosity of approximately 450,000 mPa·s, and 5.0 parts of talc powder which had a specific surface area measured by the BET method of 9 m^2/g and a D50 average particle size measured by the laser diffraction method of 5 μm. Furthermore, 0.3

parts of a dimethylpolysiloxane solution, as the component (D), which contained as a platinum content a platinum-divinyltetramethyldisiloxane complex in an amount of 1%, and 0.1 parts of ethynylcyclohexanol were added. The mixture was thoroughly mixed in a stirring and mixing device to prepare a rubber base.

[0056]

<Manufacturing Method of Silicone Composition for Airbag Coating>

A silicone composition for an airbag coating was manufactured by adding necessary additives to this rubber base.

The details and the added amount in terms of parts for each component in each of examples and comparative examples are shown in Table 1 and Table 2.

[0057]

<Selecting Method of Base Cloth>

As a base cloth, there were used a polyamide base cloth which is a flat woven fabric including a 470 decitex thread, and a polyester base cloth including a 555 decitex thread, both having been scoured.

[0058]

<Coating Method>

The base cloth was coated with the silicone composition for an airbag coating using a knife coater, and the coating was cured in a drying furnace at a temperature of 180°C for a curing time of 60 seconds.

[0059]

<Measurement Method of Physical Properties of Silicone Composition for Airbag Coating>

The obtained silicone composition was press-cured at a temperature of 170°C for a curing time of 5 minutes to prepare a cured sheet having a thickness of 2 mm. This was measured for hardness (type A durometer) and elongation at break in accordance with JIS K 6249.

[0060]

<Adhesion Test Method of Coating Sample>

The adhesion state of the cured film was observed in a rubbing test. The coated fabric was cut out to obtain a sample having a length of 10 cm and a width of 5 cm. A rubbing test was performed while a 10 N load was applied on the cured film. The measurement was performed using an INC-1507-A scrub tester (manufactured by Imoto Machinery Co., Ltd.) in accordance with ISO 5981. The surface state was visually observed to see whether or not a pinhole or peeling exists.

[0061]

<Wet Heat Test Method of Coating Sample>

The coated fabric was retained under the environment of a temperature of 80°C and a relative humidity of 95% for 500 hours. Thereafter, a rubbing test by the above-described adhesion test method was performed. The test result in each of Examples and Comparative Examples is shown in Table 3.

[0062]

<Example 1>

To 78.6 parts of the rubber base obtained by the above-described preparation method, 14.5 parts of fumed silica, as the component (C), having a specific surface area measured by the BET method of 300 m^2/g was added. The mixture was thoroughly mixed in a stirring and mixing device. To this mixture, added were the component (B-1) of 0.17 parts of a methylhydrogenpolysiloxane (hydrogen content: 1.6%) in which both terminals were blocked with a trimethylsiloxy group, and the viscosity at 25°C was 30 mPa·s, and 0.25 parts of a methylhydrogenpolysiloxane (hydrogen content: 0.8%) in which both terminals were blocked with a trimethylsiloxy group, and the viscosity at 25°C was 35 mPa·s, and the component (B-2) of 2.5 parts of a methylhydrogenpolysiloxane (hydrogen content: 0.05%) in which both terminals were blocked with dimethylhydrogensiloxy, and the viscosity at 25°C was 50 mPa·s, and 2.5 parts of a methylhydrogenpolysiloxane (hydrogen content: 0.01%) in which both terminals were blocked with a dimethylhydrogensiloxy group, and the viscosity at 25°C was 1000 mPa·s. The mixture was thoroughly mixed in a stirring and mixing device. It is noted that the ratio of the total number of silicon atom-bonded hydrogen atoms contained in the component (B-2) in this formulation was 27% relative to the total number of hydrogen atoms.

Furthermore, there were added 0.5 parts of 3-glycidoxypropyltrimethoxysilane as the additive of the component (E), 0.3 parts by mass of trimethylsilanol as the component (F), 0.25

parts of 3-methacryloxypropyltrimethoxysilane as the component having the function of improving adhesiveness of the silicone composition of the component (G), and 0.5 parts of titanium ethylacetoacetate. Then, this prepared product was applied onto each of the polyamide base cloth and the polyester cloth with approximately 50 g/m^2. The coating was cured in a drying furnace to manufacture a coated cloth. Two coated cloths were manufactured for each of the polyamide base cloth and the polyester cloth.

[0063]

One of the manufactured coated cloths was left to stand at room temperature for 24 hours. Thereafter, the adhesion state was observed in a rubbing test. As a result, a pinhole and/or peeling were not observed even after rubbing 1200 times in each of the polyamide base cloth and the polyester cloth, and favorable adhesiveness was initially exhibited. Another of the manufactured coated cloths was retained in a wet heat test machine at a temperature of 80°C and a relative humidity of 95% for 500 hours. Thereafter, a rubbing test was performed. As a result, adhesiveness was lower than that in the initial stage, but rubbing was performed 600 times, in each base cloth. Also, the hardness of the cured sheet was 23, and the elongation at break was 850%.

[0064]

<Example 2>

A product was manufactured according to the same formulation as Example 1, except that 0.5 parts of an organohydrogenpolysiloxane represented by formula (1) below (hydrogen content: 0.05%) in which the viscosity at 25°C was 165 mPa·s was further added as the component (B-1),

$$HR^1_2SiO\text{-}(HR^1SiO)_m\text{-}(R^1_2SiO)_n\text{-}SiR^1_2H \quad (1)$$

wherein R^1 is a methyl group, m = 10, n = 90, and t = 0.1.

The ratio of the total number of silicon atom-bonded hydrogen atoms contained in the component (B-2) in this formulation was 24% relative to the total number of hydrogen atoms.

[0065]

Similarly to Example 1, in each base cloth, a pinhole and/or peeling were not observed after rubbing 1200 times or more in the rubbing test after the coated film was left to stand at room temperature for 24 hours. After wet heat, the polyamide base cloth withstood 800 times, and the polyester base cloth withstood 600 times. The hardness of the cured sheet was 22, and the elongation at break was 830%.

[0066]

<Example 3>

A product was manufactured according to the formulation of Example 2, except that 0.25 parts of a methylphenylsiloxane·methylhydrogensiloxane copolymer (hydrogen content: 0.8%) in which both terminals were blocked with a trimethylsiloxy group, and the viscosity at 25°C was 35 mPa·s was used in place of 0.25 parts of the methylhydrogenpolysiloxane (hydrogen content: 0.8%), as the component (B-1) of Example 2, in which both terminals were blocked with a trimethylsiloxy group, and the viscosity at 25°C was 35 mPa·s,. The ratio of the total number of silicon atom-bonded hydrogen atoms contained in the component (B-2) in this formulation was 27%.

[0067]

In each base cloth, a pinhole and/or peeling were not observed even after rubbing 1200 times in the rubbing test after the coated film was left to stand at room temperature for 24 hours. After wet heat, the polyamide base cloth and the polyester base cloth withstood 800 times. The hardness of the cured sheet was 21, and the elongation at break was 880%.

[0068]

<Comparative Example 1>

A product was manufactured in the formulation of Example 3, except that 5 parts of a methylhydrogenpolysiloxane (hydrogen content: 0.18%) in which both terminals were blocked with a dimethylhydrogensiloxy group, and the viscosity at 25°C was 9 mPa·s was formulated in place of the component (B-2) of Example 3 including the methylhydrogenpolysiloxane (hydrogen content: 0.05%) in which both terminals were blocked with a dimethylhydrogensiloxy group, and the viscosity at 25°C was 50 mPa·s, and the methylhydrogenpolysiloxane (hydrogen content: 0.01%) in which both terminals were blocked with a dimethylhydrogensiloxy group, and the viscosity at 25°C was 1000 mPa·s. The ratio of the total number of silicon atom-bonded hydrogen atoms contained in the component (B-2) in this formulation was 62%.

[0069]

In each of the polyamide base cloth and the polyester base cloth, a pinhole and/or peeling were observed after rubbing 600 times in the rubbing test after the coated cloth was left to stand at room temperature for 24 hours. After wet heat, the adhesiveness drastically decreased to 200 times. The hardness of the cured sheet was 10, indicating soft, and the elongation at break was 1200%.

[0070]

<Comparative Example 2>

A product was manufactured according to the formulation of Example 3, except that the 3-glycidoxypropyltrimethoxysilane as the component (E) was not contained.

[0071]

In the polyamide base cloth, a pinhole and/or peeling were observed when rubbing 300 times in the rubbing test after the coated film was left to stand at room temperature for 24 hours, and when rubbing 100 times after wet heat. In the polyester base cloth, a pinhole and/or peeling were observed when rubbing 400 times in an initial stage, and when rubbing 200 times after wet heat. The hardness of the cured sheet was 24, and the elongation at break was 830%.

[0072]

<Comparative Example 3>

A product was manufactured according to the formulation of

Example 3, except that the titanium ethylacetoacetate as the component (G) was not contained.

[0073]

In the polyamide base cloth, a pinhole and/or peeling were observed when rubbing 600 times in the rubbing test after the coated film was left to stand at room temperature for 24 hours, and when rubbing 200 times after wet heat. In the polyester base cloth, a pinhole and/or peeling were observed when rubbing 300 times in an initial stage, and when rubbing 100 times after wet heat. The hardness of the cured sheet was 24, and the elongation at break was 830%.

[0074]

[Table 1]		Example 1	Example 2	Example 3	Comparative Example 1	Comparative Example 2	Comparative Example 3
	Rubber base (Component (A) (alkenyl group-containing organopolysiloxane), Component (D) (catalyst), talc, retardant)	78.6	78.6	78.6	78.6	78.6	78.8
	Component (B-1) (organohydrogenpolysiloxane)	0.42	0.92	0.92	0.92	0.92	0.92
	Component (B-2) (organohydrogenpolysiloxane)	5.0	5.0	5.0	5.0	5.0	5.0
	Component (C) (fumed silica)	14.5	14.5	14.5	14.5	14.5	14.5
	Component (E) (3-glycidoxypropyltrimethoxysilane)	0.50	0.50	0.50	0.50	-	0.50
	Component (F) (trimethylsilanol)	0.30	0.30	0.30	0.30	0.30	0.30
	Component (G) (3-methacryloxypropyltrimethoxylsilane)	0.25	0.25	0.25	0.25	0.25	0.25
	Component (G) (titanium ethyl acetoacetate)	0.50	0.50	0.50	0.50	0.50	-

[0075]

[Table 2]		Both terminals	Side chain	Viscosity (mPa·s/25°C)	Example 1	Example 2	Example 3	Comparative Example 1	Comparative Example 2	Comparative Example 3
	Component (B-1)-1	Me_3	Me, H	30	0.17	0.17	0.17	0.17	0.17	0.17
	Component (B-1)-2	Me_3	Me, H	35	0.25	0.25	-	-	-	-
	Component (B-1)-3	Me_2H	Me, H	165	-	0.5	0.5	0.5	0.5	0.5
	Component (B-1)-4	Me_3	Me, Ph	35	-	-	0.25	0.25	0.25	0.25
	Component (B-2)-1	Me_2H	Me_2	50	2.5	2.5	2.5	-	2.5	2.5
	Component (B-2)-2	Me_2H	Me_2	1,000	2.5	2.5	2.5	-	2.5	2.5
	Component (B-2)-3	Me_2H	Me_2	9	-	-	-	5	-	-
Ratio (%) of number of SiHs in Component (B-2) to total number of SiHs					27	24	24	62	24	24

[0076]

[Table 3]	Example 1	Example 2	Example 3	Comparative Example 1	Comparative Example 2	Comparative Example 3
Coating amount (g/m^2)	50	50	50	50	50	50
Curing properties (180°C x 60 sec)	Cured	Cured	Cured	Cured	Cured	Cured
Hardness	23	22	21	10	24	24
Elongation (%)	850	830	880	1200	830	830
Adhesiveness to polyamide base cloth						
Rubbing test (initial) (times)	1200 or more	1200 or more	1200 or more	600	300	600
Rubbing test (after wet heat) (times) After 80°C x 95%RH x 500 h	600	800	800	200	100	200
Adhesiveness to polyester base cloth						
Rubbing test (initial) (times)	1200 or more	1200 or more	1200 or more	600	400	300
Rubbing test (after wet heat) (times) After 80°C x 95%RH x 500 h	600	600	800	200	200	100

INDUSTRIAL APPLICABILITY

[0077]

The present invention relates to a silicone composition for a coating on a base cloth used for an airbag of an automobile and the like. Since the cured product of the silicone composition according to the present invention is excellent in elongation, an intended internal pressure can be retained after the actuation of an airbag, and the cured film having excellent adhesiveness to a polyamide base cloth and a polyester base cloth can be formed even under high temperature and high humidity. Thus, the silicone composition according to the present invention can be suitably used for an airbag which is highly safe as an airbag such as a curtain airbag.

CLAIMS

1. A silicone rubber composition for an airbag coating, comprising:

(A) 100 parts by mass of a diorganopolysiloxane that contains two or more silicon atom-bonded alkenyl groups in one molecule and has a viscosity at 25°C of 100 to 500,000 mPa·s;

(B-1) an organohydrogenpolysiloxane that contains one or more silicon atom-bonded hydrogen atoms in one molecule at a portion other than both terminals of a molecular chain thereof, and 0 or more hydrogen atoms at both terminals of the molecular chain thereof, and has a viscosity at 25°C of 1 to 2,000 mPa·s;

(B-2) a linear organohydrogenpolysiloxane that contains a silicon atom-bonded hydrogen atom only at both terminals of a molecular chain thereof, and has a viscosity at 25°C of 1 to 2,000 mPa·s;

(C) a micronized silica having a specific surface area by a BET method of 50 m^2/g or more;

(D) an addition reaction catalyst;

(E) an organosilicon compound having an epoxy group and a silicon atom-bonded alkoxy group in one molecule; and

(F) a silane that contains one silanol group in one molecule or a siloxane compound with 2 to 4 silicon atoms, wherein

5 to 50 parts by mass of the micronized silica (C) and

0.1 to 10 parts by mass of the organosilicon compound (E) are contained relative to 100 parts by mass of the diorganopolysiloxane (A),

the addition reaction catalyst (D) is contained in a sufficient amount for curing the silicone composition, and

a total number of the silicon atom-bonded hydrogen atoms contained in the linear organohydrogenpolysiloxane (B-2) is 10 to 60% of a total number of the silicon atom-bonded hydrogen atoms contained in the organohydrogenpolysiloxane (B-1) and the linear organohydrogenpolysiloxane (B-2).

2. The silicone rubber composition for an airbag coating according to claim 1, comprising (G) 0.05 to 10 parts by mass of a component having a function of improving adhesiveness of the silicone composition, relative to 100 parts by mass of the diorganopolysiloxane (A).

3. The silicone rubber composition for an airbag coating according to claim 1 or 2, wherein

the organohydrogenpolysiloxane (B-1) includes a compound represented by general formula (1) below:

$$HR^1_2SiO\text{-}(HR_1SiO)_m\text{-}(R^1_2SiO)_n\text{-}SiR^1_2H \quad (1)$$

(wherein R_1s are the same as or different from each other, and each an unsubstituted or halogen-substituted monovalent hydrocarbon group having 1 to 10 carbon atoms which independently does not have an unsaturated aliphatic bond, m is a positive number of 1 to 50, n is a positive number of 0 to 150, and t represented by formula: $t = m/(m + n)$ satisfies $0.01 \leq t \leq 1.0$).

4. The silicone rubber composition for an airbag coating according to any one of claims 1 to 3, wherein

the organohydrogenpolysiloxane (B-1) has a trimetylsiloxy group at both terminals of the molecular chain, and contains at least one aromatic group bonded to a silicon atom in the molecule.

5. The silicone rubber composition for an airbag coating according to any one of claims 1 to 4, wherein

the component (G) having the function of improving adhesiveness of the silicone composition is an organometallic compound selected from the group consisting of an organic titanium compound, an organic zirconium compound, and an organic aluminum compound.

6. An airbag base cloth comprising a cured product of the silicone composition according to any one of claims 1 to 5.

7. An airbag comprising the airbag base cloth according to claim 6.

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/075806

A. CLASSIFICATION OF SUBJECT MATTER
INV. C09D183/04
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C09D C08G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2006/177673 A1 (IKENO MASAYUKI [JP] ET AL) 10 August 2006 (2006-08-10) paragraphs [0002], [0010] - [0070]	1-7
X	& JP 2006 241438 A (SHINETSU CHEMICAL CO) 14 September 2006 (2006-09-14) cited in the application -----	1-7

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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