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(54) Title: CURABLE SILICONE COMPOSITION AND CURED PRODUCT THEREOF

(57) Abstract: The present invnetion relates to a curable silicone composition comprises: (A) an organopolysiloxane represented by the average composition formula: $R_aSiO_{(4-a)/2}$ (in the formula, R is a halogen-substituted or unsubstituted monovalent hydrocarbon group, but from 0.1 to 2.1 mol% of the groups represented by R are alkenyl groups, and "a" is a number from 1.9 to 2.4); (B) an organopolysiloxane having an average of 2 silicon-bonded hydrogen atoms in a molecule, in an amount such that silicon-bonded hydrogen atoms in component (B) is from 0.1 to 3.0 moles relative to 1 mole of alkenyl groups in component (A); and (C) a platinum-based catalyst, wherein a content of component (C) is an amount such that a content of platinum atoms is from 10 to 100 ppm, in terms of mass units, relative to the present composition, and a content of each of sodium and potassium in the present composition is 3 ppm or less, in terms of mass units, relative to the present composition. The curable silicone composition forms a cured product having excellent heat resistance, and a cured product having excellent heat resistance.

DESCRIPTION

CURABLE SILICONE COMPOSITION AND CURED PRODUCT THEREOF

Technical Field

[0001] The present invention relates to a curable silicone composition and a cured product thereof.

[0002] Priority is claimed on Japanese Patent Application No. 2012-178613, filed on August 10, 2012, the content of which is incorporated herein by reference.

Background Art

[0003] A curable silicone composition comprising: an organopolysiloxane composed of a siloxane unit represented by the formula: $(CH_3)_2SiO_{2/2}$, a siloxane unit represented by the formula: $CH_3SiO_{3/2}$, a siloxane unit represented by the formula: $(CH_3)_3SiO_{1/2}$ and a siloxane unit represented by the formula: $(CH_3)_2(CH_2=CH)SiO_{1/2}$; an organopolysiloxane having an average of 1 or more silicon-bonded hydrogen atoms in a molecule; and a platinum-based catalyst forms, upon curing, a gel-like cured product having excellent stress relaxation, and is therefore used as a protective agent for an electronic circuit, and the like (see Japanese Unexamined Patent Application Publication No. S58-007452).

[0004] However, this cured product has the problem of undergoing significant changes in hardness when exposed to elevated temperatures.

[0005] As a result, a curable silicone composition comprising: an organopolysiloxane composed of a siloxane unit represented by the formula: $(CH_3)_2SiO_{2/2}$, a siloxane unit represented by the formula: $CH_3SiO_{3/2}$, a siloxane unit represented by the formula: $(CH_3)_3SiO_{1/2}$ and a siloxane unit represented by the formula: $(CH_3)_2(CH_2=CH)SiO_{1/2}$; a diorganopolysiloxane capped at both molecular terminals with vinyl groups; a diorganopolysiloxane capped at both molecular terminals with silicon-bonded hydrogen atoms; and a platinum-based catalyst (see Japanese Unexamined Patent Application Publication No. S62-181357), and a curable silicone composition comprising: an organopolysiloxane composed of a siloxane unit represented by the general formula: $R'_2SiO_{2/2}$, a siloxane unit represented by the general formula: $R'SiO_{3/2}$, a siloxane unit represented by the general formula: $R'_3SiO_{1/2}$ and a siloxane unit represented by the general formula: $R'_2R''SiO_{1/2}$ (in the formulae, R' is a monovalent hydrocarbon group other than an alkenyl group, but at least one R' is an aryl group, R" is an alkenyl group, and a content of aryl groups is at least 0.01 mol% relative to the total content of R' and

R"); an organopolysiloxane having at least 2 silicon-bonded hydrogen atoms in a molecule; and a platinum-based catalyst (see Japanese Unexamined Patent Application Publication No. 2000-169714) have been proposed.

[0006] However, even these curable silicone compositions exhibit inadequate heat resistance of cured products thereof.

[0007] An objective of the present invention is to provide a curable silicone composition that forms a cured product having excellent heat resistance, and a cured product having excellent heat resistance.

Disclosure of Invention

[0008] The curable silicone composition of the present invention comprises:

(A) an organopolysiloxane represented by the average composition formula:

$R_aSiO_{(4-a)/2}$

in the formula, R is a halogen-substituted or unsubstituted monovalent hydrocarbon group, but from 0.1 to 2.1 mol% of the gourps represented by R are alkenyl groups, and "a" is a number from 1.9 to 2.4;

(B) an organopolysiloxane having an average of 2 silicon-bonded hydrogen atoms in a molecule, in an amount such that silicon-bonded hydrogen atoms in component (B) is from 0.1 to 3.0 moles relative to 1 mole of alkenyl groups in component (A); and

(C) a platinum-based catalyst,

wherein a content of component (C) is an amount such that a content of platinum atoms is from 10 to 100 ppm, in terms of mass units, relative to the present composition, and a content of each of sodium and potassium in the present composition is 3 ppm or less, in terms of mass units, relative to the present composition.

[0009] Component (A) is preferably an organopolysiloxane composed of from 80.0 to 96.5 mol% of a siloxane unit represented by the general formula: $R^1_2SiO_{2/2}$, from 2.0 to 10.0 mol% of a siloxane unit represented by the general formula: $R^1SiO_{3/2}$, from 1.0 to 6.0 mol% of a siloxane unit represented by the general formula: $R^1_3SiO_{1/2}$ and from 0.2 to 4.0 mol% of a siloxane unit represented by the general formula: $R^1_2R^2SiO_{1/2}$ (in the formulae, R^1 is a halogen-substituted or unsubstituted monovalent hydrocarbon group not having an unsaturated aliphatic bond, and R^2 is an alkenyl group).

[0010] The cured product of the present invention is obtained by curing the above-mentioned curable silicone composition and preferably has a needle penetration, as stipulated in JIS K 6249, of from 10 to 200.

Effects of Invention

[0011] The curable silicone composition of the present invention forms a cured product having excellent heat resistance. In addition, the cured product of the present invention exhibits excellent heat resistance.

Detailed Description of the Invention

[0012] First, the curable silicone composition of the present invention will be described in detail.

[0013] The organopolysiloxane for component (A) is a base compound of the present composition, and is represented by the average composition formula:

$R_aSiO_{(4-a)/2}$

[0014] In the formula, R is a halogen-substituted or unsubstituted monovalent hydrocarbon group, specific examples of which include alkyl groups such as methyl groups, ethyl groups, propyl groups, butyl groups and pentyl groups; cycloalkyl groups such as cyclopentyl groups and cyclohexyl groups; alkenyl groups such as vinyl groups, allyl groups, butenyl groups, pentenyl groups, heptenyl groups and hexenyl groups; aryl groups such as phenyl groups, tolyl groups and xylyl groups; aralkyl groups such as benzyl groups and phenethyl groups; and halogenated alkyl groups such as 3-chloropropyl groups and 3,3,3-trifluoropropyl groups. Moreover, from 0.1 to 2.1 mol% of the groups represeted by R are alkenyl groups. In addition, a in the formula is a number from 1.9 to 2.4.

[0015] Such component (A) is preferably an organopolysiloxane composed of from 80.0 to 96.5 mol% of a siloxane unit represented by the general formula: $R^1{}_2SiO_{2/2}$, from 2.0 to 10.0 mol% of a siloxane unit represented by the general formula: $R^1SiO_{3/2}$, from 1.0 to 6.0 mol% of a siloxane unit represented by the general formula: $R^1{}_3SiO_{1/2}$ and from 0.2 to 4.0 mol% of a siloxane unit represented by the general formula: $R^1{}_2R^2SiO_{1/2}$.

[0016] In the formulae, R^1 is a halogen-substituted or unsubstituted monovalent hydrocarbon group not having an unsaturated aliphatic bond, specific examples of which include alkyl groups such as methyl groups, ethyl groups, propyl groups, butyl groups and pentyl groups; cycloalkyl groups such as cyclopentyl groups and cyclohexyl groups; aryl groups such as phenyl groups, tolyl groups and xylyl groups; aralkyl groups such as benzyl groups and phenethyl groups; and halogenated alkyl groups such as 3-chloropropyl groups and 3,3,3-trifluoropropyl groups. Furthermore, R^2 in the formula is an alkenyl group and

is exemplified by a vinyl group, an allyl group, a butenyl group, a pentenyl group, a heptenyl group, and a hexenyl group.

[0017] A viscosity at 25°C of component (A) is not limited, but preferably falls within the range of from 100 to 1,000,000 mPa·s in order for the present composition to exhibit excellent handling/workability.

[0018] Component (B) is a crosslinking agent in the present composition, and is an organopolysiloxane having an average of 2 silicon-bonded hydrogen atoms in a molecule. Specific examples of groups bonded to silicon atoms other than hydrogen atoms in component (B) include halogen-substituted or unsubstituted monovalent hydrocarbon groups not having an unsaturated aliphatic bond, such as alkyl groups such as methyl groups, ethyl groups, propyl groups, butyl groups and pentyl groups; cycloalkyl groups such as cyclopentyl groups and cyclohexyl groups; aryl groups such as phenyl groups, tolyl groups and xylyl groups; aralkyl groups such as benzyl groups and phenethyl groups; and halogenated alkyl groups such as 3-chloropropyl groups and 3,3,3-trifluoropropyl groups. A molecular structure of component (B) is not limited, and can be, for example, straight, branched, partially branched straight, cyclic, net-like or resinous, and component (B) can be a single polymer having these molecular structures or a mixture of polymers having these molecular structures. A viscosity at 25°C of component (B) is not limited, but is preferably from 1 to 100,000 mPa·s, and more preferably from 1 to 5,000 mPa·s.

[0019] A content of component (B) is an amount such that silicon-bonded hydrogen atoms in component (B) is from 0.1 to 3.0 moles relative to 1 mole of alkenyl groups in component (A). This is because the present composition is satisfactorily cured if the content of component (B) is not less than the lower limit of the above-mentioned range, and heat resistance of an obtained cured product is improved if the content of component (B) is not more than the upper limit of the above-mentioned range.

[0020] Component (C) is a platinum-based catalyst that accelerates curing of the present composition. Examples of component (C) include chloroplatinic acid, an alcohol solution of chloroplatinic acid, an olefin complex of platinum, an alkenylsiloxane complex of platinum and a carbonyl complex of platinum, with an alkenylsiloxane complex of platinum being preferred, and a 1,3-divinyltetramethyl disiloxane platinum complex being particularly preferred.

[0021] A content of component (C) is an amount such that a content of platinum atoms is from 10 to 100 ppm, in terms of mass units, relative to the present composition. This is

because the heat resistance of the obtained cured product is improved if the content of component (C) is not less than the lower limit of the above-mentioned range, and coloration of the obtained cured product is suppressed if the content of component (C) is not more than the upper limit of the above-mentioned range.

[0022] The present composition comprises components (A) to (C), wherein a content of each of sodium and potassium in the present composition is 3 ppm or less, preferably 2 ppm or less, and particularly preferably 1 ppm or less, in terms of mass units, relative to the present composition. This is because the heat resistance of the obtained cured product is improved if the content of sodium and that of potassium are not more than the upper limit of the above-mentioned range. Sodium and potassium originate mostly from a polymerization catalyst used when preparing, for example, the organopolysiloxane of component (A). As a result, examples of methods for ensuring that the content of sodium and that of potassium are not more than the upper limit of the aforementioned range in the present composition include a method involving subjecting component (A), which may contain sodium and potassium, to washing with water, treatment with an ion exchange resin or adsorption filtration or a method in which an organopolysiloxane prepared using a polymerization catalyst that contains no sodium or potassium is used as component (A). Moreover, it is preferable to use a filter material having zeta potential-derived adsorption activity when carrying out the adsorption filtration. Examples of such filter materials include the Zeta plus(TM) 01A, 05S and 05H filters manufactured by Sumitomo 3M Ltd.

[0023] The present composition comprises components (A) to (C), but may contain reaction inhibitors as optional components. Examples of the reaction inhibitor include alkyne alcohols such as 1-ethynyl-1-cyclohexanol, 2-methyl-3-butyn-2-ol, 3,5-dimethyl-1-hexyn-3-ol, 2-phenyl-3-butyn-2-ol; eneyne compounds such as 3-methyl-3-penten-1-yne, 3,5-dimethyl-3-hexen-1-yne; amine compounds such as N,N,N',N'-tetramethylethylenediamine, N,N-dimethylethylenediamine, N,N-diethylethylenediamine, N,N-dibutylethylenediamine and N,N,N',N'-tetraethylethylenediamine; cyclic siloxane compounds such as 1,3,5,7-tetramethyl-1,3,5,7-tetravinylcyclotetrasiloxane and 1,3,5,7-tetramethyl-1,3,5,7-tetrahexenylcyclotetrasiloxane; and benzotriazoles. A content of the reaction inhibitor is not limited, but is preferably in the range of from 1 to 5,000 ppm, in terms of mass units, relative to the present composition.

[0024] Furthermore, the present composition may contain, as optional components, inorganic fillers such as fumed silica, precipitated silica and fumed titanium oxide,

hydrophobization-treated inorganic fillers obtained by treating these inorganic fillers with organosilicon compounds; flame retardants; pigments; dyes; fluorescent dyes; heat-resistant additives; plasticizers; and adhesion-imparting agents at quantities that do not impair the objective of the present invention.

[0025] The present composition can form a gel-like cured product by rapidly curing the present composition either at ambient temperature or upon heating to a temperature of from 40 to 200°C.

[0026] The cured product of the present invention will now be described in detail.

[0027] The cured product of the present invention can be obtained by curing the above-mentioned curable silicone composition. Hardness of the cured product is not particularly limited, but it is preferable for the cured product to have a needle penetration, as stipulated in JIS K 6249:2003 "Testing methods for uncured and cured silicone rubber", of from 20 to 200.

Examples

[0028] The curable silicone composition of the present invention and the cured product thereof will now be described using practical examples. Note that the viscosity is the value at 25°C. In addition, the curable silicone composition and the cured product were evaluated as follows.

[0029]

[Content of sodium and potassium]

2 g portions of the curable silicone composition were weighed out and dissolved in 60 ml of toluene, 20 g of pure water was added to the obtained solution and extraction was carried out for a period of 2 hours using a shaker. The aqueous layer was removed using a plastic pipette and used as an ion chromatography measurement sample.

[0030] An ICS-1500 manufactured by Dionex was used as the ion chromatography apparatus for measuring sodium ions and potassium ions. A 20 mmol/L aqueous solution of methanesulfonic acid was flushed as an eluant at 1.0 ml/min using an Ionpac CS-12A/CG-12A as a separation column. An electrodialyzing type CRS-300 suppressor and an electrical conductivity detector were used. The detection limit in this measurement method was 0.1 ppm.

[0031]

[Needle penetration]

40 g portions of the curable silicone composition were placed in 50 ml glass beakers and cured by being heated at 120°C for 60 minutes. This cured product was cooled to 25°C, after which the needle penetration stipulated in JIS K 6249 was measured. This value was recorded as the needle penetration prior to a heat resistance test.

[0032]

[Heat resistance test]

The cured product prepared as described above was placed in a circulating hot air oven at 200°C, and the needle penetration of the cured product after 500 hours in the oven was measured in the same way as described above. This value was recorded as the needle penetration after a heat resistance test (1).

[0033] In addition, the cured product subjected to the above-mentioned heat resistance test was placed in a circulating hot air oven at 200°C and heated for a further 500 hours (a total of 1000 hours), and the needle penetration of the cured product after 1000 hours in the oven was measured in the same way as described above. This value was recorded as the needle penetration after a heat resistance test (2).

[0034]

[Reference Examples]

19.7 g of an organopolysiloxane represented by the formula:

$(CH_3)_2(CH_2=CH)SiO[(CH_3)_2SiO]_7Si(CH_3)_2(CH_2=CH)$

and a mixture comprising 565.2 g of a cyclic dimethylsiloxane represented by the formula:

$[(CH_3)_2SiO]_X$

(in the formula, X is a number from 4 to 6)

and 215.3 g of a liquid organopolysiloxane composed of 7.4 mol% of a siloxane unit represented by the formula: $(CH_3)_3SiO_{1/2}$, 81.8 mol% of a siloxane unit represented by the formula: $(CH_3)_2SiO_{2/2}$ and 10.8 mol% of a siloxane unit represented by the formula: $CH_3SiO_{3/2}$ were purged with N_2, 0.1 g of a 45 mass% aqueous solution of potassium hydroxide was added as an equilibrium catalyst, and an equilibrium reaction was carried out at 150°C for 4 hours. The reaction product was then neutralized with CO_2, cooled, and filtered once using a Zeta Plus (TM) 01A filter manufactured by Sumitomo 3M Ltd. The obtained organopolysiloxane (I) had a viscosity of 800 mPa·s and a vinyl group content of 0.19 mass%.

[0035] In addition, it was found from NMR analysis that this organopolysiloxane (I) was composed of 94.6 mol% of a siloxane unit represented by the formula: $(CH_3)_2SiO_{2/2}$,

2.9 mol% of a siloxane unit represented by the formula: $CH_3SiO_{3/2}$, 2.0 mol% of a siloxane unit represented by the formula: $(CH_3)_3SiO_{1/2}$ and 0.5 mol% of a siloxane unit represented by the formula: $(CH_3)_2(CH_2=CH)SiO_{1/2}$ and was represented by the average composition formula:

$(CH_3)_{1.991}(CH_2=CH)_{0.005}SiO_{1.002}$

[0036] This organopolysiloxane (I) was filtered further 2 times using a Zeta Plus (TM) 01A filter to give an organopolysiloxane (II).

[0037] In addition, this organopolysiloxane (I) was filtered further 5 times using a Zeta Plus (TM) 01A filter to give an organopolysiloxane (III).

[0038] Furthermore, this organopolysiloxane (I) was filtered further 2 times using a Zeta Plus (TM) 01A filter and then filtered once using a Zeta Plus (TM) 05S filter manufactured by Sumitomo 3M Ltd. to give an organopolysiloxane (IV).

[0039]

[Practical Examples 1 to 14 and Comparative Examples 1 to 8]

Curable silicone compositions of Practical Examples 1 to 14 and Comparative Examples 1 to 8 were prepared by homogeneously mixing the compositions (parts by mass) shown in Tables 1 to 3 using the components listed below. Moreover, the SiH/Vi values in the tables refer to the number of moles of silicon-bonded hydrogen atoms contained in component (b-1) relative to 1 mole of vinyl groups contained in components (a-1) to (a-4) in the composition.

Component (a-1): Organopolysiloxane (IV) prepared in the reference examples

Component (a-2): Organopolysiloxane (III) prepared in the reference examples

Component (a-3): Organopolysiloxane (II) prepared in the reference examples

Component (a-4): Organopolysiloxane (I) prepared in the reference examples

Component (b-1): Polydimethylsiloxane capped at both molecular terminals with dimethylhydrogensiloxy groups and having a viscosity of 5 mPa·s (content of silicon-bonded hydrogen atoms: 0.12 mass%)

Component (c-1): 1,3-divinyltetramethyl disiloxane solution of 1,3-divinyltetramethyl disiloxane platinum complex having a platinum concentration of 0.5 mass% in terms of platinum atoms

Component (d-1): N,N,N',N'-tetramethylethylenediamine

Component (d-2): 2-phenyl-3-butyn-2-ol

[0040]

Table 1

		Practical Examples					
		1	2	3	4	5	6
Composition of curable silicone compositions (parts by mass)	Component (a-1)	91.9	-	-	93.3	-	-
	Component (a-2)	-	91.9	-	-	93.3	-
	Component (a-3)	-	-	91.9	-	-	93.3
	Component (b-1)	6.5	6.5	6.5	5.9	5.9	5.9
	Component (c-1)	2.00	2.00	2.00	1.00	1.00	1.00
	Component (d-1)	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
SiH/Vi		1.2	1.2	1.2	1.1	1.1	1.1
Sodium content (ppm)		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Potassium content (ppm)		<0.1	0.5	1.0	<0.1	0.5	1.0
Content of platinum atoms (ppm)		100.0	100.0	100.0	50.0	50.0	50.0
Heat resistance	Needle penetration prior to heat resistance test	96	93	93	93	93	92
	Needle penetration after heat resistance test (1)	99	98	93	99	98	98
	Needle penetration after heat resistance test (2)	93	92	90	94	95	93

[0041]

Table 2

		Practical Examples							
		7	8	9	10	11	12	13	14
Composition of curable silicone compositions (parts by mass)	Component (a-1)	94.2	-	-	94.5	-	-	-	-
	Component (a-2)	-	94.2	-	-	94.5	93.3	94.2	94.5
	Component (a-3)	-	-	94.2	-	-	-	-	-
	Component (b-1)	5.4	5.4	5.4	5.3	5.3	5.9	5.4	5.3
	Component (c-1)	0.40	0.40	0.40	0.20	0.20	1.00	0.40	0.20
	Component (d-1)	0.0025	0.0025	0.0025	0.0025	0.0025	-	-	-
	Component (d-2)	-	-	-	-	-	0.0050	0.0050	0.0050
SiH/Vi		1.0	1.0	1.0	1.0	1.0	1.1	1.0	1.0
Sodium content (ppm)		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Potassium content (ppm)		<0.1	0.5	1.0	<0.1	0.5	0.5	0.5	0.5
Content of platinum atoms (ppm)		20.0	20.0	20.0	10.0	10.0	50.0	20.0	10.0
Heat resistance	Needle penetration prior to heat resistance test	95	94	95	93	92	95	100	96
	Needle penetration after heat resistance test (1)	99	97	96	95	94	88	95	95
	Needle penetration after heat resistance test (2)	94	95	82	89	93	84	94	94

[0042]

Table 3

		Comparative Examples							
		1	2	3	4	5	6	7	8
Composition of curable silicone compositions (parts by mass)	Component (a-1)	94.7	-	-	-	-	-	-	-
	Component (a-2)	-	94.7	-	-	-	-	-	-
	Component (a-3)	-	-	94.7	-	-	-	-	-
	Component (a-4)	-	-	-	94.7	94.5	94.2	93.3	91.9
	Component (b-1)	5.2	5.2	5.2	5.2	5.3	5.4	5.9	6.5
	Component (c-1)	0.10	0.10	0.10	0.10	0.20	0.40	1.00	2.00
	Component (d-1)	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
SiH/Vi		0.9	0.9	0.9	0.9	1.0	1.0	1.1	1.2
Sodium content (ppm)		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Potassium content (ppm)		<0.1	0.5	1.0	5.0	5.0	5.0	5.0	5.0
Content of platinum atoms (ppm)		5.0	5.0	5.0	5.0	10.0	20.0	50.0	100.0
Heat resistance	Needle penetration prior to heat resistance test	98	96	95	93	93	95	93	94
	Needle penetration after heat resistance test (1)	96	88	95	0	52	59	79	78
	Needle penetration after heat resistance test (2)	4	0	8	0	0	59	53	49

Industrial Applicability

[0043] The curable silicone composition of the present invention can form a cured product having excellent heat resistance, and is therefore suitable for use as a potting agent for an electronic part such as a power module, for which heat resistance is required.

CLAIMS

1. A curable silicone composition comprising:

(A) an organopolysiloxane represented by the average composition formula:

$R_aSiO_{(4-a)/2}$

wherein, R is a halogen-substituted or unsubstituted monovalent hydrocarbon group, but from 0.1 to 2.1 mol% of the groups represented by R are alkenyl groups, and "a" is a number from 1.9 to 2.4;

(B) an organopolysiloxane having an average of 2 silicon-bonded hydrogen atoms in a molecule, in an amount such that silicon-bonded hydrogen atoms in component (B) is from 0.1 to 3.0 moles relative to 1 mole of alkenyl groups in component (A); and

(C) a platinum-based catalyst,

a content of component (C) being an amount such that a content of platinum atoms is from 10 to 100 ppm, in terms of mass units, relative to the present composition, and a content of each of sodium and potassium in the present composition being 3 ppm or less, in terms of mass units, relative to the present composition.

2. The curable silicone composition according to Claim 1, wherein component (A) is an organopolysiloxane composed of from 80.0 to 96.5 mol% of a siloxane unit represented by the general formula: $R^1{}_2SiO_{2/2}$, from 2.0 to 10.0 mol% of a siloxane unit represented by the general formula: $R^1SiO_{3/2}$, from 1.0 to 6.0 mol% of a siloxane unit represented by the general formula: $R^1{}_3SiO_{1/2}$ and from 0.2 to 4.0 mol% of a siloxane unit represented by the general formula: $R^1{}_2R^2SiO_{1/2}$, wherein, R^1 is a halogen-substituted or unsubstituted monovalent hydrocarbon group not having an unsaturated aliphatic bond, and R^2 is an alkenyl group.

3. A cured product, that is obtained by curing the curable silicone composition described in Claim 1 or 2.

4. The cured product according to Claim 3, wherein a needle penetration stipulated in JIS K 6249 is from 10 to 200.