

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization International Bureau



(43) International Publication Date  
3 June 2004 (03.06.2004)

PCT

(10) International Publication Number  
**WO 2004/046249 A1**

(51) International Patent Classification<sup>7</sup>: **C08L 83/04**, C09D 183/04

(21) International Application Number: PCT/US2003/035184

(22) International Filing Date: 5 November 2003 (05.11.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data: 10/295,789 15 November 2002 (15.11.2002) US

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(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States (regional): ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 2004/046249 A1

(54) Title: STAR-BRANCHED SILICONE POLYMERS AS ANTI-MIST ADDITIVES FOR COATING APPLICATIONS

(57) Abstract: A hydrido-silicone is incompletely reacted with (preferably) a long chain olefin under hydrosilylation conditions to produce a partially substituted hydrido-silicone that is further reacted under hydrosilylation conditions with a vinyl containing MQ resin to partially consume the remaining hydride species which is then reacted under hydrosilylation conditions to consume the remaining hydride species with a long chain di- or multi-alkenyl silicone to produce a composition that is useful as an anti-mist agent in the coating of flexible supports.

## STAR-BRANCHED SILICONE POLYMERS AS ANTI -MIST ADDITIVES FOR COATING APPLICATIONS

### FIELD OF USE

The present invention relates to coating flexible materials or supports such as sheets of paper or other polymeric material, either woven or non-woven, with a silicone composition. The present invention also relates to the coating of flexible materials or supports with liquid compositions comprising one or more cross-linkable polyorganosiloxanes wherein such polyorganosiloxanes are cross-linkable by an addition reaction, a condensation reaction, a cationic reaction, or a free-radical reaction. The present invention also relates to star branched polyorganosiloxanes (silicone polymers) that reduce misting during the application of the silicone composition (polyorganosiloxane) to the flexible material or support. The flexible support may be paper, cardboard, plastic film, metal film and the like. Some exemplary applications are paper for foodstuffs, adhesive labels, adhesive tapes, seals and the like.

### BACKGROUND OF THE INVENTION

The coating of flexible supports with liquid silicones is typically carried out on coating devices that operate continuously at very high speed. These devices usually comprise coating heads composed of several rolls, including in particular a pressure roll and a coating roll that are continuously fed with a silicone composition that may or may not be cross-linkable, by means of a series of rolls that are placed next to one another. A strip of flexible support of the desired material to be coated is fed at high speed between the pressure roll and the coating roll to be coated on at least one of its surfaces. When it is intended to cross link the silicone coating, apparatus to implement a cross linking reaction are

positioned downstream of the coating head. The apparatus that implements cross linking may be for example an oven or an emitter of radiation, e.g. ultraviolet (UV) radiation or an emitter of a beam of electrons (EB).

High speed coating of flexible supports with silicones has been associated with problems associated with the transfer of the silicone liquid (or fluid) from the coating roll to the flexible support, which moves forward through the coating apparatus. One of the particular problems associated with transfer of the silicone liquid from the coating roll to the flexible support is the appearance of a fog, mist or aerosol in the immediate vicinity of the coating head and particularly close to the points of contact between the coating roll and the flexible support being coated. Typically, the density of this fog, mist or aerosol increases with an increase in the forward speed of the flexible support being coated by the apparatus.

The first effect of this transfer problem is to reduce the amount of silicone liquid actually transferred to the flexible support. A second effect is for the droplets comprising the fog, mist or aerosol to condense onto the newly coated flexible support downstream of the coating rolls creating an orange peel effect. This orange peel effect, or coating non-uniformity, creates problems with coverage, the mechanical properties of the coating, e.g. ruboff, and adhesion resistance.

An additional problem caused by non-uniformity in the coating is related to industrial hygiene and the safety of people operating the coating equipment who are working in the vicinity of the coating equipment.

## SUMMARY OF THE INVENTION

The present invention provides for a composition comprising the hydrosilylation reaction product of:

compound A +  $\alpha (M_\alpha M^{V_i} \beta D_\gamma D^{V_i} \delta T_\phi T^{V_i} \lambda)$

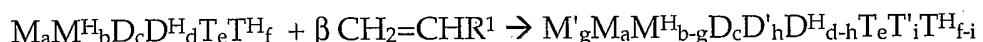
where the subscripts  $\alpha, \beta, \gamma, \delta, \phi$ , and  $\lambda$  are zero or positive and  $\beta + \delta + \lambda \geq 2$ , and the stoichiometric coefficient  $\alpha$  has a value of such that  $((\beta + \delta + \lambda) / ((b + d + f) - (g + h + i) - (k + m + o)))$  is 0.01 to 10 where Compound A is the reaction product of:

$M'_g M_a M^{H_{b-g}} D_c D'_h D^{H_{d-h}} T_e T'_i T^{H_{f-i}}$  and  $((M_j M^{V_i} \lambda D_l D^{V_i} m T_n T^{V_i} o)_p Q)_q$

in the presence of a noble metal hydrosilylation catalyst where the subscripts a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, are zero or positive and q is non-zero and positive, for mixtures of compounds the average values of each of the subscripts will most likely be non-integral, for specific compounds the subscripts will be integral, with  $k + m + o < b + d + f - g - h - i$ , p ranges from 0.4 to 4.0 and q ranges from 1 to 200, the ratio  $(b + d + f - g - h - i) / (((k + m + o)p)q)$  ranges from 50.0 to 0.01 and where the compound:

$M'_g M_a M^{H_{b-g}} D_c D'_h D^{H_{d-h}} T_e T'_i T^{H_{f-i}}$

is the hydrosilylation product of the following reaction:



where the stoichiometric coefficient  $\beta$  satisfies the following relationship:

$\beta + 1 \leq b + d + f$  and  $b + d + f - g - h - i > 0$  with  $1.5 \leq b + d + f \leq 100$ ;

$2 \leq a + b \leq 12$ ;  $0 \leq c + d \leq 1000$ ;  $0 \leq e + f \leq 10$  and  $R^1$  is a monovalent radical selected from the group consisting of halogens, hydrogen, C1 to C60 monovalent hydrocarbon radicals, C1 to C60 monovalent polyester radicals, C1 to C60 monovalent nitrile radicals, C1 to C60 monovalent alkyl halide radicals and C1 to C60 monovalent polyether radicals and mixtures thereof; with

$M = R^2 R^3 R^4 Si O_{1/2}$ ;

$$M^H = HR^5R^6SiO_{1/2};$$
$$M^{Vi} = R^{Vi}R^5R^6SiO_{1/2};$$
$$D = R^7R^8SiO_{2/2};$$
$$D^H = HR^9SiO_{2/2};$$
$$D^{Vi} = R^{Vi}R^{10}SiO_{2/2};$$
$$T = R^{11}SiO_{3/2};$$
$$T^H = HSiO_{3/2};$$
$$T^{Vi} = R^{Vi}SiO_{3/2};$$
$$Q = SiO_{4/2};$$
$$M' = (CH_2CHR^1)R^5R^6SiO_{1/2};$$
$$D' = (CH_2CHR^1)R^9SiO_{2/2}; \text{ and}$$
$$T' = (CH_2CHR^1)SiO_{3/2}$$

with each  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ ,  $R^{10}$ , and  $R^{11}$  independently selected for each molecular species from the group of C1 to C60 monovalent hydrocarbon radicals and each  $R^{Vi}$  independently selected from the group of C2 to C60 monovalent alkenyl hydrocarbon radicals.

The present invention further provides for a process to reduce misting in the coating of a flexible substrate said process comprising preparing a coating composition for coating said substrate and adding thereto the compositions of the present invention.

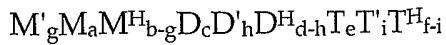
#### DETAILED DESCRIPTION OF THE INVENTION

The star branched siloxane compounds of the present invention are made as the hydrosilylation reaction product of:

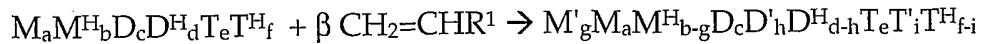
compound A +  $\alpha (M_\alpha M^{Vi_\beta} D_\gamma D^{Vi_\delta} T_\phi T^{Vi_\lambda})$  where the subscripts  $\alpha, \beta, \gamma, \delta, \phi$ , and  $\lambda$  are zero or positive and  $\beta + \delta + \lambda \geq 2$ , for mixtures of compounds the average values of each of the subscripts will most likely be non-integral, for specific compounds the subscripts will be integral, and the stoichiometric coefficient  $\alpha$  has a value of such that  $((\beta + \delta + \lambda) / ((b + d + f) - (g + h + i) - (k + m + o)))$  is 0.01 to 10, preferably 0.01 to 5, more preferably 0.10 to 5 and most preferably 0.2 to 1.0 where Compound A is the reaction product of:

$M'_g M_a M^{H_{b-g}} D_c D'_h D^{H_{d-h}} T_e T'_i T^{H_{f-i}}$  and  $((M_j M^{Vi_k} D_l D^{Vi_m} T_n T^{Vi_o})_p Q)_q$

in the presence of a noble metal hydrosilylation catalyst where the subscripts a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, are zero or positive and q is non-zero and positive, for mixtures of compounds the average values of each of the subscripts will most likely be non-integral, for specific compounds the subscripts will be integral, with  $k + m + o < b + d + f - g - h - i$ , p ranges from 0.4 to 4.0, preferably 0.5 to 3.0, more preferably 0.5 to 2.5 and most preferably 0.5 to 1.5 and all sub-ranges there between and q ranges from 1 to 200, preferably 1 to 100, more preferably 1 to 75 and most preferably 1 to 50 and all sub-ranges there between where the ratio between the hydride containing precursor and the vinyl containing precursor is defined by the following mathematical relationship between the stoichiometric subscripts of the precursors,  $(b + d + f - g - h - i) / ((k + m + o)p)q$  ranges from 50.0 to 0.01, preferably from 10.0 to 0.10; more preferably from 5.0 to 0.20 and most preferably from 4.0 to 0.25 and all sub-ranges there between and specifically including 3.5 to 0.25; 3.0 to 0.25; 2.5 to 0.25 and 2.0 to 0.25; and where the compound:



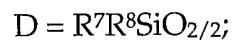
may be obtained by the following reaction:



where the stoichiometric coefficient  $\beta$  satisfies the following relationship:

$\beta + 1 \leq b + d + f$  and  $b + d + f - g - h - i > 0$  with  $1.5 \leq b + d + f \leq 100$ ;

$2 \leq a + b \leq 12$ ;  $0 \leq c + d \leq 1000$ ;  $0 \leq e + f \leq 10$  and  $R^1$  is a monovalent radical selected from the group consisting of halogens, hydrogen, C1 to C60 monovalent hydrocarbon radicals, C1 to C60 monovalent polyester radicals, C1 to C60 monovalent nitrile radicals, C1 to C60 monovalent alkyl halide radicals and C1 to C60 monovalent polyether radicals and mixtures thereof; with



$M' = (CH_2CHR^1)R^5R^6SiO_{1/2};$

$D' = (CH_2CHR^1)R^9SiO_{2/2};$  and

$T' = (CH_2CHR^1)SiO_{3/2}$

with each  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ ,  $R^{10}$ , and  $R^{11}$  independently selected for each molecular species from the group of C1 to C60 monovalent hydrocarbon radicals and each  $R^{Vi}$  independently selected from the group of C2 to C60 monovalent alkenyl hydrocarbon radicals. Methods for making MQ resins, such as  $((M_jM^{Vi_k}D_lD^{Vi_m}T_nT^{Vi_o})_pQ)_q$ , are described in US patent 5,817,729, US patent 5,399,614 and US patent 2,676,182 herewith and hereby specifically incorporated by reference. The phrase C1 to C60 is a carbon number range ranging from 1 to 60 and includes both aliphatic and aromatic radicals, e.g. styryl, this range also includes the following specific sub-ranges, 15 to 60, 30 to 60, 45 to 60, 1 to 15, 1 to 30, 1 to 45, 10 to 30, 10 to 40, 10 to 50 and all sub-ranges therebetween.

The star branched silicone compounds of the present invention are described as the reaction product of the following two compounds:

$M'_gM_aM^{H_{b-g}}D_cD'_hD^{H_{d-h}}TeT'_iT^{H_{f-i}}$  and  $((M_jM^{Vi_k}D_lD^{Vi_m}T_nT^{Vi_o})_pQ)_q$ , because of the multiplicity of hydrosilylation sites available for reaction on each of the component molecules being reacted and the difficulties of reducing such a stochastic chemical reaction to an analytic description.

The compositions of the present invention may be made by neat reactions or by reactions where the reactants are diluted by solvent. Because of the long chain nature of the substituents in these materials, neat reactions, i.e. reactions conducted in the absence of any non-participating solvent, will tend to produce products that conform to the molecular descriptions

herein but possessing a more entangled macro-structure. If less entangled macro-structures of these compounds are desired, the preparative reactions should be conducted in suitable solvent media, e.g. cyclic siloxanes, inert hydrocarbon solvents and the like.

Many types of noble metal catalysts for this hydrosilylation reaction are known and such catalysts may be used for the reaction in the present instance. When optical clarity is required the preferred catalysts are catalysts that are soluble in the reaction mixture. By noble metal, Applicants define Ru, Rh, Pd, Os, Ir, and Pt as noble metals and also include Ni in the definition because of its known hydrogenation activity. Preferably the catalyst is a platinum compound and the platinum compound can be selected from those having the formula  $(PtCl_2Olefin)$  and  $H(PtCl_3Olefin)$  as described in U.S. patent number 3,159,601, hereby incorporated by reference. The olefin shown in the previous two formulas can be almost any type of olefin but is preferably an alkenylene having from 2 to 8 carbon atoms, a cycloalkenylene have from 5 to 7 carbon atoms or styrene. Specific olefins utilizable in the above formulas are ethylene, propylene, the various isomers of butylene, octylene, cyclopentene, cyclohexene, cycloheptene, and the like.

A further platinum containing material usable in the compositions of the present invention is the cyclopropane complex of platinum chloride described in U.S. patent number 3,159,662 hereby incorporated by reference.

Further the platinum containing material can be a complex formed from chloroplatinic acid with up to 2 moles per gram of platinum of a member selected from the class consisting of alcohols, ethers, aldehydes and mixtures of the above as described in U.S. patent number 3,220,972 hereby incorporated by reference.

The catalyst preferred for use with liquid injection molding compositions are described in U. S. Patents numbers 3,715,334; 3,775,452; and 3,814,730 to Karstedt. Additional background concerning the art may be found at J. L. Spier, "Homogeneous Catalysis of Hydrosilation by Transition Metals, in *Advances in Organometallic Chemistry*, volume 17, pages 407 through 447, F.G.A. Stone and R. West editors, published by the Academic Press (New York, 1979). Persons skilled in the art can easily determine an effective amount of platinum catalyst. Generally, an effective amount for hydrosilylation ranges from about 0.1 to 50 parts per million of the total organopolysiloxane composition and all sub-ranges there between.

## EXPERIMENTAL

### EXAMPLE 1

By way of example, 19.9 grams (0.083 moles) of a C16-18 alpha olefin was mixed under a blanket of nitrogen gas with 1000 grams ( 0.21 moles) of a silyl hydride terminated polydimethylsiloxane and 5 ppm Pt added as Karstedt catalyst. The reaction was heated and stirred at 95 °C for approximately four hours to allow the olefin to add to the siloxane polymer. Quantitative chemical analysis of residual SiH indicated that the desired amount of hydrogen had been consumed in attaching the olefin to the siloxane. Optionally this product may be isolated before further reaction.

6.5 grams (.062 moles) of an  $((M^{Vi})_2Q)_4$  resin was added to the product of the first reaction. An additional 5 ppm Pt as Karstedt catalyst was added and the reaction stirred and heated to 95 °C for approximately four hours. Quantitative chemical analysis indicated that the vinyl and hydride functional groups had reacted to the desired degree.

67.6 grams (.016 moles) of a vinyl terminated polydimethylsiloxane was added to the solution and the reaction was heated for four hours at 85 C. A dramatic increase in viscosity indicated the completion of the hydrosilylation reaction.

## EXAMPLE 2

### Solvent assisted reactions

1.5 grams (0.006 moles) of a C16-18 alpha olefin was mixed under a blanket of nitrogen gas with 75 grams ( 0.015 moles) of a silyl hydride terminated polydimethylsiloxane and 5 ppm Pt added as Karstedt catalyst. The reaction was heated and stirred at 95 °C for approximately four hours to allow the olefin to add to the siloxane polymer. Quantitative chemical analysis of residual SiH indicated that the desired amount of hydrogen had been consumed in attaching the olefin to the siloxane. Optionally this product may be isolated before further reaction.

0.486 grams (0.0047 moles) of an  $((M^{Vi})_2Q)_4$  resin was added to the product of the first reaction. An additional 5 ppm Pt as Karstedt catalyst was added and the reaction stirred and heated to 95 °C for approximately four hours. Quantitative chemical analysis indicated that the vinyl and hydride functional groups had reacted to the desired degree.

5.07 grams (0.0012 moles) of a vinyl terminated polydimethylsiloxane was added to the solution and the reaction was heated for four hours at 85 C. A dramatic increase in viscosity indicated the completion of the hydrosilylation reaction. The reaction was cooled.

0.0098 grams (1.9 X 10-5 moles) of an alkyl amine was added and the reaction stirred for one hour. 75 grams of a vinyl terminated polysiloxane was added to the solution as a carrier solvent. The Isopar C was removed by vacuum distillation from the solution to leave the product in solution.

Table 1 shows examples of the synthesis of the structures of the anti mist additives based on the path described above. The SiH/SiVinyl is the ratio of moles of silyl hydrides available for reaction to the moles of silyl vinyl available for reaction. In the compounds shown, the SiH/SiVinyl ratio runs from 0.2 to 2.75, but a larger usable range spans from 0.22 to 4.5.

Table 2 shows the anti misting behavior of the invention. The measurements were made during runs on 2.5 mil SC Rhi-Liner 12 paper using a pilot coater with a line speed of 2000 ft/minute. The paper was coated with a standard silicone paper release formulation containing ~ 0.2% anti mist additive with a target of 0.6 to 0.9 pounds per ream. The mist was measured using a DustTrack Aerosol Monitor. The intake port was positioned in the highest observed misting area thus providing the highest expected values. The position does not reflect normal environmental testing nor does it guarantee specific values under all operating conditions. The measurement is in mg of mist material per cubic meter of air, the lower values being more desirable as they represent less misting.

The results show the anti misting materials generated for this invention reduce the amount of generated mist at 2000 ft/min compared to the control formulation containing no anti mist additive. Quite surprisingly the mist is often reduced by a factor of greater than ten, often by about 100

Table 1: Anti Mist Additive Synthesis

Example	Olefin	Grams	Silyl Hydride	Grams	ppm Pt	SiH/SiVinyl	gms ((Mvi)2Q)4	ppm Pt	MviD115Mvi
61	C16-18	6.0	MHD125MH	300	10	1.75	2.2	5	3.5
62	C16-18	6.0	MHD125MH	300	10	2.00	1.9	5	12.2
63	C16-18	3.2	MHD125MH	160	10	2.00	1.0	5	12.4
64	C16-18	19.9	MHD125MH	1000	5	2.00	6.5	5	131.8
65	C16-18	38.5	MHD125MH	1935	5	2.00	12.5	5	130.8
66	C16-18	8.9	MHD125MH	449	5	2.00	3.2	5	37.1

## Reacted in Isopar C and Solvent exchanged with MviD115Mvi

Example	Olefin	Grams	Silyl Hydride	Grams	ppm Pt	Isopar C	SiH/SiVinyl	gms (Mvi)2Q4	ppm Pt	MviD115Mvi	Amine	MviDxMvi
81	C16-18	8.9	MHD125MH	449	5	492	2.00	3.20	5	37.1	0.10	500
82	C16-18	2.0	MHD125MH	125	5	136	1.80	0.95	5	8.5	0.16	136.7
83	C16-18	2.2	MHD125MH	125	5	140	1.80	0.95	5	8.5	0.16	136.7

Table 2: Anti Mist Measurements

AMA #	mg/m <sup>3</sup> at 2000 ft/min
control	102.00
61	0.40
62	1.20
63	0.57
64	1.22
65	3.80
66	0.70

## Reacted in Isopar C and Solvent exchanged with MviD115Mvi

AMA #	mg/m <sup>3</sup> at 2000 ft/min
81	1.12
82	1.16
83	1.26

The foregoing examples are merely illustrative of the invention, serving to illustrate only some of the features of the present invention. The appended claims are intended to claim the invention as broadly as it has been conceived and the examples herein presented are illustrative of selected embodiments from a manifold of all possible embodiments. Accordingly it is Applicants' intention that the appended claims are not to be limited by the choice of

examples utilized to illustrate features of the present invention. As used in the claims, the word "comprises" and its grammatical variants logically also subtend and include phrases of varying and differing extent such as for example, but not limited thereto, "consisting essentially of" and "consisting of." Where necessary, ranges have been supplied, those ranges are inclusive of all sub-ranges there between. It is to be expected that variations in these ranges will suggest themselves to a practitioner having ordinary skill in the art and where not already dedicated to the public, those variations should where possible be construed to be covered by the appended claims. It is also anticipated that advances in science and technology will make equivalents and substitutions possible that are not now contemplated by reason of the imprecision of language and these variations should also be construed where possible to be covered by the appended claims. All United States patents referenced herein are herewith and hereby specifically incorporated by reference.

## WHAT IS CLAIMED IS:

1. A composition comprising the hydrosilylation reaction product of:

compound A +  $\alpha (M_\alpha M^{Vi_\beta} D_\gamma D^{Vi_\delta} T_\phi T^{Vi_\lambda})$

where the subscripts  $\alpha, \beta, \gamma, \delta, \phi$ , and  $\lambda$  are zero or positive and  $\beta + \delta + \lambda \geq 2$ , and the stoichiometric coefficient  $\alpha$  has a value of such that

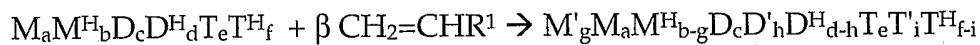
$((\beta + \delta + \lambda) / ((b + d + f) - (g + h + i) - (k + m + o)))$  is 0.01 to 10 where Compound A is the reaction product of:

$M'_g M_a M^{H_{b-g}} D_c D'^h D^{H_{d-h}} T_e T'^i T^{H_{f-i}}$  and  $((M_j M^{Vi_k} D_l D^{Vi_m} T_n T^{Vi_o})_p Q)_q$ ,

in the presence of a noble metal hydrosilylation catalyst where the subscripts a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, are zero or positive and q is non-zero and positive, for mixtures of compounds the average values of each of the subscripts will most likely be non-integral, for specific compounds the subscripts will be integral, with  $k + m + o < b + d + f - g - h - i$ , p ranges from 0.4 to 4.0 and q ranges from 1 to 200, the ratio  $(b + d + f - g - h - i) / ((k + m + o)p)q$  ranges from 50.0 to 0.01 and where the compound:

$M'_g M_a M^{H_{b-g}} D_c D'^h D^{H_{d-h}} T_e T'^i T^{H_{f-i}}$

is the hydrosilylation product of the following reaction:



where the stoichiometric coefficient  $\beta$  satisfies the following relationship:

$\beta + 1 \leq b + d + f$  and  $b + d + f - g - h - i > 0$  with  $1.5 \leq b + d + f \leq 100$ ;

$2 \leq a + b \leq 12$ ;  $0 \leq c + d \leq 1000$ ;  $0 \leq e + f \leq 10$  and  $R^1$  is a monovalent radical selected from the group consisting of halogens, hydrogen, C1 to C60 monovalent hydrocarbon radicals, C1 to C60 monovalent polyester radicals, C1 to C60 monovalent nitrile radicals, C1 to C60 monovalent

alkyl halide radicals and C1 to C60 monovalent polyether radicals and mixtures thereof; with

$M = R^2R^3R^4SiO_{1/2};$

$M^H = HR^5R^6SiO_{1/2};$

$M^{Vi} = R^{Vi}R^5R^6SiO_{1/2};$

$D = R^7R^8SiO_{2/2};$

$D^H = HR^9SiO_{2/2};$

$D^{Vi} = R^{Vi}R^{10}SiO_{2/2};$

$T = R^{11}SiO_{3/2};$

$T^H = HSiO_{3/2};$

$T^{Vi} = R^{Vi}SiO_{3/2};$

$Q = SiO_{4/2};$

$M' = (CH_2CHR^1)R^5R^6SiO_{1/2};$

$D' = (CH_2CHR^1)R^9SiO_{2/2};$  and

$T' = (CH_2CHR^1)SiO_{3/2}$

with each  $R^2, R^3, R^4, R^5, R^6, R^7, R^8, R^9, R^{10}$ , and  $R^{11}$  independently selected for each molecular species from the group of C1 to C60 monovalent hydrocarbon radicals and each  $R^{Vi}$  independently selected from the group of C2 to C60 monovalent alkenyl hydrocarbon radicals.

2. The composition of claim 1 wherein  $R^1$  a is selected from the group consisting of C15 to C60 monovalent hydrocarbon radicals, C15 to C60

monovalent polyester radicals, C15 to C60 monovalent nitrile radicals, C15 to C60 monovalent alkyl halide radicals, C15 to C60 monovalent polyether radicals and mixtures thereof.

3. The composition of claim 1 wherein R<sup>1</sup> a is selected from the group consisting of C30 to C60 monovalent hydrocarbon radicals, C30 to C60 monovalent polyester radicals, C30 to C60 monovalent nitrile radicals, C30 to C60 monovalent alkyl halide radicals, C30 to C60 monovalent polyether radicals and mixtures thereof.
4. The composition of claim 1 wherein R<sup>1</sup> a is selected from the group consisting of C10 to C40 monovalent hydrocarbon radicals, C10 to C40 monovalent polyester radicals, C10 to C40 monovalent nitrile radicals, C10 to C40 monovalent alkyl halide radicals, C10 to C40 monovalent polyether radicals and mixtures thereof.
5. The composition of claim 2 where each R<sup>2</sup>, R<sup>3</sup>, R<sup>4</sup>, R<sup>5</sup>, R<sup>6</sup>, R<sup>7</sup>, R<sup>8</sup>, R<sup>9</sup>, R<sup>10</sup>, and R<sup>11</sup> are methyl.
6. The composition of claim 3 where each R<sup>2</sup>, R<sup>3</sup>, R<sup>4</sup>, R<sup>5</sup>, R<sup>6</sup>, R<sup>7</sup>, R<sup>8</sup>, R<sup>9</sup>, R<sup>10</sup>, and R<sup>11</sup> are methyl.
7. The composition of claim 4 where each R<sup>2</sup>, R<sup>3</sup>, R<sup>4</sup>, R<sup>5</sup>, R<sup>6</sup>, R<sup>7</sup>, R<sup>8</sup>, R<sup>9</sup>, R<sup>10</sup>, and R<sup>11</sup> are methyl.
8. The composition of claim 1 wherein R<sup>1</sup> is styryl.
9. The composition of claim 7 where each R<sup>2</sup>, R<sup>3</sup>, R<sup>4</sup>, R<sup>5</sup>, R<sup>6</sup>, R<sup>7</sup>, R<sup>8</sup>, R<sup>9</sup>, R<sup>10</sup>, and R<sup>11</sup> are methyl.
10. The composition of claim 7 where each R<sup>2</sup>, R<sup>3</sup>, R<sup>4</sup>, R<sup>5</sup>, R<sup>6</sup>, R<sup>7</sup>, R<sup>8</sup>, R<sup>9</sup>, R<sup>10</sup>, and R<sup>11</sup> are selected from the group consisting of C30 to C60 monovalent hydrocarbon radicals, C30 to C60 monovalent polyester

radicals, C30 to C60 monovalent nitrile radicals, C30 to C60 monovalent alkyl halide radicals, C1 to C60 monovalent polyether radicals and mixtures thereof.

11. A composition to reduce misting during the coating of flexible supports comprising the hydrosilylation reaction product of compound A +  $\alpha (M_\alpha M^{Vi_\beta} D_\gamma D^{Vi_\delta} T_\phi T^{Vi_\lambda})$

where the subscripts  $\alpha, \beta, \gamma, \delta, \phi$ , and  $\lambda$  are zero or positive and  $\beta + \delta + \lambda \geq 2$ , and the stoichiometric coefficient  $\alpha$  has a value of such that

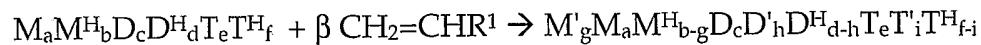
$((\beta + \delta + \lambda) / ((b + d + f) - (g + h + i) - (k + m + o)))$  is 0.01 to 10 where Compound A is the reaction product of:

$M'_g M_a M^{H_{b-g}} D_c D'^h D^{H_{d-h}} T_e T'^i T^{H_{f-i}}$  and  $((M_j M^{Vi_k} D_l D^{Vi_m} T_n T^{Vi_o})_p Q)_q$ ,

in the presence of a noble metal hydrosilylation catalyst where the subscripts a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, are zero or positive and q is non-zero and positive, for mixtures of compounds the average values of each of the subscripts will most likely be non-integral, for specific compounds the subscripts will be integral, with  $k + m + o < b + d + f - g - h - i$ , p ranges from 0.4 to 4.0 and q ranges from 1 to 200, the ratio  $(b + d + f - g - h - i) / ((k + m + o)p)q$  ranges from 50.0 to 0.01 and where the compound:

$M'_g M_a M^{H_{b-g}} D_c D'^h D^{H_{d-h}} T_e T'^i T^{H_{f-i}}$

is the hydrosilylation product of the following reaction:



where the stoichiometric coefficient  $\beta$  satisfies the following relationship:

$\beta + 1 \leq b + d + f$  and  $b + d + f - g - h - i > 0$  with  $1.5 \leq b + d + f \leq 100$ ;

$2 \leq a + b \leq 12$ ;  $0 \leq c + d \leq 1000$ ;  $0 \leq e + f \leq 10$  and  $R^1$  is a monovalent radical selected from the group consisting of halogens, hydrogen, C1 to C60 monovalent hydrocarbon radicals, C1 to C60 monovalent polyester radicals, C1 to C60 monovalent nitrile radicals, C1 to C60 monovalent alkyl halide radicals and C1 to C60 monovalent polyether radicals and mixtures thereof; with

$M = R^2R^3R^4SiO_{1/2}$ ;

$M^H = HR^5R^6SiO_{1/2}$ ;

$M^{Vi} = R^{Vi}R^5R^6SiO_{1/2}$ ;

$D = R^7R^8SiO_{2/2}$ ;

$D^H = HR^9SiO_{2/2}$ ;

$D^{Vi} = R^{Vi}R^{10}SiO_{2/2}$ ;

$T = R^{11}SiO_{3/2}$ ;

$T^H = HSiO_{3/2}$ ;

$T^{Vi} = R^{Vi}SiO_{3/2}$ ;

$Q = SiO_{4/2}$ ;

$M' = (CH_2CHR^1)R^5R^6SiO_{1/2}$ ;

$D' = (CH_2CHR^1)R^9SiO_{2/2}$ ; and

$T' = (CH_2CHR^1)SiO_{3/2}$

with each  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ ,  $R^{10}$ , and  $R^{11}$  independently selected for each molecular species from the group of C1 to C60

monovalent hydrocarbon radicals and each  $R^{Vi}$  independently selected from the group of C2 to C60 monovalent alkenyl hydrocarbon radicals.

12. The composition of claim 11 wherein  $R^1a$  is selected from the group consisting of C1 to C60 monovalent hydrocarbon radicals, C1 to C60 monovalent polyester radicals, C1 to C60 monovalent nitrile radicals, C1 to C60 monovalent alkyl halide radicals, C1 to C60 monovalent polyether radicals and mixtures thereof.

13. The composition of claim 11 wherein  $R^1a$  is selected from the group consisting of C15 to C60 monovalent hydrocarbon radicals, C15 to C60 monovalent polyester radicals, C15 to C60 monovalent nitrile radicals, C15 to C60 monovalent alkyl halide radicals, C1 to C60 monovalent polyether radicals and mixtures thereof.

14. The composition of claim 11 wherein  $R^1a$  is selected from the group consisting of C30 to C60 monovalent hydrocarbon radicals, C30 to C60 monovalent polyester radicals, C30 to C60 monovalent nitrile radicals, C30 to C60 monovalent alkyl halide radicals, C1 to C60 monovalent polyether radicals and mixtures thereof.

15. The composition of claim 12 where each  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ ,  $R^{10}$ , and  $R^{11}$  are methyl.

16. The composition of claim 13 where each  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ ,  $R^{10}$ , and  $R^{11}$  are methyl.

17. The composition of claim 14 where each  $R^2$ ,  $R^3$ ,  $R^4$ ,  $R^5$ ,  $R^6$ ,  $R^7$ ,  $R^8$ ,  $R^9$ ,  $R^{10}$ , and  $R^{11}$  are methyl.

18. The composition of claim 11 wherein  $R^1$  is styryl.

19. The composition of claim 17 where each R<sup>2</sup>, R<sup>3</sup>, R<sup>4</sup>, R<sup>5</sup>, R<sup>6</sup>, R<sup>7</sup>, R<sup>8</sup>, R<sup>9</sup>, R<sup>10</sup>, and R<sup>11</sup> are methyl.

20. The composition of claim 17 where each R<sup>2</sup>, R<sup>3</sup>, R<sup>4</sup>, R<sup>5</sup>, R<sup>6</sup>, R<sup>7</sup>, R<sup>8</sup>, R<sup>9</sup>, R<sup>10</sup>, and R<sup>11</sup> are selected from the group consisting of C30 to C60 monovalent hydrocarbon radicals, C30 to C60 monovalent polyester radicals, C30 to C60 monovalent nitrile radicals, C30 to C60 monovalent alkyl halide radicals, C1 to C60 monovalent polyether radicals and mixtures thereof.

21. A process to reduce misting in the coating of a flexible substrate said process comprising preparing a coating composition for coating said substrate and adding thereto the composition of claim 1.

22. A process to reduce misting in the coating of a flexible substrate said process comprising preparing a coating composition for coating said substrate and adding thereto the composition of claim 2.

23. A process to reduce misting in the coating of a flexible substrate said process comprising preparing a coating composition for coating said substrate and adding thereto the composition of claim 3.

24. A process to reduce misting in the coating of a flexible substrate said process comprising preparing a coating composition for coating said substrate and adding thereto the composition of claim 4.

25. A process to reduce misting in the coating of a flexible substrate said process comprising preparing a coating composition for coating said substrate and adding thereto the composition of claim 5.

26. A process to reduce misting in the coating of a flexible substrate said process comprising preparing a coating composition for coating said substrate and adding thereto the composition of claim 6.

27. A process to reduce misting in the coating of a flexible substrate said process comprising preparing a coating composition for coating said substrate and adding thereto the composition of claim 7.

28. A process to reduce misting in the coating of a flexible substrate said process comprising preparing a coating composition for coating said substrate and adding thereto the composition of claim 8.

29. A process to reduce misting in the coating of a flexible substrate said process comprising preparing a coating composition for coating said substrate and adding thereto the composition of claim 9.

30. A process to reduce misting in the coating of a flexible substrate said process comprising preparing a coating composition for coating said substrate and adding thereto the composition of claim 10.

**INTERNATIONAL SEARCH REPORT**

International Application No

PCT/US 03/35184

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 C08L83/04 C09D183/04

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)

IPC 7 C08L C09D C08K

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 practical, search terms used)

EPO-Internal, WPI Data, PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category <sup>o</sup>	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 108 208 A (GEN ELECTRIC) 16 May 1984 (1984-05-16) examples ---	1-30
A	EP 0 980 903 A (DOW CORNING) 23 February 2000 (2000-02-23) paragraph '0070! ---	1-30
A	EP 0 652 257 A (DOW CORNING) 10 May 1995 (1995-05-10) examples ---	1-30
P, A	EP 1 277 786 A (WACKER CHEMIE GMBH) 22 January 2003 (2003-01-22) examples ---	1-30 -/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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- "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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- "&" document member of the same patent family

Date of the actual completion of the international search

16 March 2004

Date of mailing of the international search report

23/03/2004

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**INTERNATIONAL SEARCH REPORT**

International Application No

PCT/US 03/35184

**C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT**

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,A	EP 1 323 768 A (WACKER CHEMIE GMBH) 2 July 2003 (2003-07-02) examples -----	1-30

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Information on patent family members

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