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Technical Field

Moisture-curing composition having good mechanical properties and good adhesion properties, comprising at least one silane-functional polymer and at least one α -functional organodialkoxysilane, suitable as an elastic adhesive, as an elastic sealant or coating.

Prior Art

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Moisture-curing compositions based on silane-functional polymers are known, and their uses include elastic adhesives, most sealants, and coatings, all free from isocyanate groups potentially detrimental to health. For the majority of these applications, as a joint sealant or as an assembly adhesive, for example, it is critical for the composition in the cured state to possess good mechanical properties and good adhesion properties. Particularly important is a combination of high extensibility with high tensile strength. Compositions of this kind often fail to satisfy these requirements.

The use of organoalkylsilanes as additives in moisture-curing compositions based on silane-functional polymers is known. They are typically employed in order to exert a targeted influence over properties such as adhesion, storage stability, and reactivity, as described in US 3,979,344, US 5,147,927 and EP 0 819 749 A2, for example. From US 3,979,344, for example, the use is known, for example, of N-(2-aminoethyl)-3-aminopropyltrimethoxysilane for achieving good adhesion properties.

WO 03/014226 A1 describes alkoxy-crosslinking one-component sealants based on alkoxyorganosilane-terminated polymers featuring good storage stability and curing characteristics, the sealants having

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organoalkoxysilanes added to them in relatively large quantities, as drying agents, from a broad range of α -functional silanes.

5 **Exposition of the Invention**

Given the state of the art, a need exists for an isocyanate-free moisture-curing composition which features increased extensibility in conjunction with
10 high reactivity, good adhesion properties, and high tensile strength.

Surprisingly it has been found that moisture-curing compositions of claim 1, comprising certain silane-
15 functional polymers, and comprising at least one aminosilane as accelerant and adhesion promoter, exhibit a significantly increased extensibility in the cured state, as a result of the accompanying use of defined amounts of certain α -functional
20 organodialkoxysilanes, while retaining good reactivity, tensile strength, and adhesion.

Experience shows that moisture-curing compositions comprising silane-functional polymers are substantially
25 improved in their adhesion properties as a result of the accompanying use of aminosilanes such as N-(2-aminoethyl)-3-aminopropyltrimethoxysilane. The presence of aminosilanes, such as N-(2-aminoethyl)-3-aminopropyltrimethoxysilane, for example,
30 unfortunately leads to unwanted detractions from the extensibility of the cured composition. If, on the other hand, a combination of an aminosilane, such as N-(2-aminoethyl)-3-aminopropyltrimethoxysilane, for example, and a defined amount of certain α -functional
35 organodialkoxysilanes is used in moisture-curing compositions comprising certain silane-functional polymers, then isocyanate-free moisture-curing compositions are obtainable which feature high

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reactivity, good adhesion properties, high tensile strengths, and significantly increased extensibility.

Ways of Performing the Invention

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The invention provides moisture-curing compositions as defined in claim 1 with increased extensibility, suitable as elastic adhesives, elastic sealants or coatings.

10

The term "polymer" in the present document embraces, on the one hand, a group of chemically uniform macromolecules which nevertheless differ in respect of degree of polymerization, molar mass, and chain length, prepared by a polymerization reaction (addition polymerization, polyaddition, polycondensation). On the other hand the term also embraces derivatives of such a group of macromolecules from polymerization reactions, in other words compounds which have been obtained by reactions, such as addition reactions or substitution reactions, for example, of functional groups on existing macromolecules and which may be chemically uniform or chemically nonuniform. The term further embraces what are known as prepolymers - that is, reactive oligomeric preadducts whose functional groups are involved in the construction of macromolecules.

20
25

The term "polyurethane polymer" encompasses all polymers which are prepared by the diisocyanate polyaddition process. This also includes those polymers which are virtually or entirely free from urethane groups, such as polyether-polyurethanes, polyester-polyurethanes, polyether-polyureas, polyureas, polyester-polyureas, polyisocyanurates, polycarbodiimides, and so on.

30
35

The term "organoalkoxysilane", or "silane" for short, is used in the present document to refer to compounds

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in which firstly there are at least one, typically two or three, alkoxy group(s) attached directly to the silicon atom (via an Si-O bond) and which, secondly, have at least one organic radical attached directly to the silicon atom (via an Si-C bond). Correspondingly, the term "silane group" refers to the silicon-containing group attached to the organic radical of the organoalkoxysilane. The organoalkoxysilanes, or their silane groups, have the property of hydrolyzing on contact with moisture. This hydrolysis is accompanied by the formation of organosilanols, i.e., organosilicon compounds containing one or more silanol groups (Si-OH groups) and, as a result of subsequent condensation reactions, of organosiloxanes, i.e., organosilicon compounds containing one or more siloxane groups (Si-O-Si groups).

The term " α -functional organodialkoxysilane" identifies a silane as depicted in formula (I) which on its silicon carries not only a methylene group but also two alkoxy groups, the methylene group carrying a functional group which is therefore positioned α to the silicon atom. Silanes referred to as " γ -functional" are those which carry, on the organic radical, a functional group positioned γ to the silicon atom.

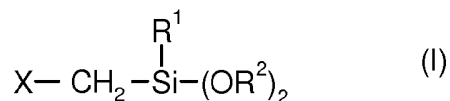
Terms such as "aminosilane" and "isocyanatosilane" refer to silanes which have the corresponding functional group, in this case, accordingly, aminoalkylalkoxysilanes and isocyanatoalkylalkoxysilanes.

The term "silane-functional" refers to compounds, more particularly polymers, which have silane groups.

The moisture-curing composition comprises at least one silane of the formula (I) in an amount of 0.6 - 5.0 parts by weight, preferably 0.6 - 3.5 parts

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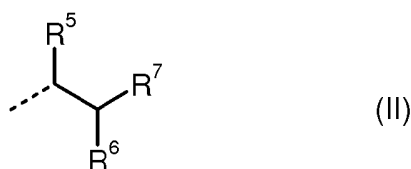
by weight, based on 100 parts by weight of polymer **A**,



where

- 5 R^1 is an alkyl group having 1 to 8 C atoms, more particularly a methyl or a ethyl group,
 R^2 is an alkyl group having 1 to 5 C atoms, more particularly a methyl group or an ethyl group or an isopropyl group, and
 10 X is a radical which is attached via a heteroatom and is selected from the group encompassing $-\text{NHR}^3$, $-\text{NHCOOR}^4$, $-\text{SH}$, $-\text{OR}^4$, $\text{R}^4\text{COO}-$, $\text{CH}_2=\text{C}(\text{CH}_3)\text{COO}-$, and $\text{CH}_2=\text{CHCOO}-$,
 where

- 15 R^3 is a hydrogen atom or is a linear or branched hydrocarbon radical having 1 to 20 C atoms, which optionally contains cyclic fractions, or is a radical of the formula (II)



20 where

- R^5 and R^6 , independently of one another, is a hydrogen atom or is a radical from the group encompassing R^8 , $-\text{COOR}^8$, and $-\text{CN}$, and
 R^7 is a hydrogen atom or is a radical from the
 25 group encompassing $-\text{CH}_2-\text{COOR}^8$, $-\text{COOR}^8$, $-\text{CN}$, $-\text{NO}_2$, $-\text{PO}(\text{OR}^8)_2$, $-\text{SO}_2\text{R}^8$ and $-\text{SO}_2\text{OR}^8$,
 where
 R^8 is a hydrocarbon radical having 1 to 20 C atoms and optionally containing at least one heteroatom,
 30 and

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R⁴ is an optionally substituted hydrocarbon radical having 1 to 20 C atoms.

Dashed lines in the formulae in each case identify the
5 bonding sites.

The following silanes (I) are preferred:

N-phenylaminomethyldimethoxymethylsilane, N-cyclohexyl-
aminomethyldimethoxymethylsilane, N-methylaminomethyl-
10 dimethoxymethylsilane, N-ethylaminomethyldimethoxy-
methylsilane, N-propylaminomethyldimethoxymethylsilane,
N-butylaminomethyldimethoxymethylsilane, (methacryloyl-
oxymethyl)-dimethoxymethylsilane, N-(dimethoxymethyl-
15 silylmethyl)-O-methylcarbamate, the products from the
Michaellike addition reaction of aminomethyldimethoxy-
methylsilane with Michael acceptors such as maleic
diesters, fumaric diesters, citraconic diesters,
acrylic esters, methacrylic esters, cinnamic esters,
itaconic diesters, vinylphosphonic diesters,
20 vinylsulfonic aryl esters, vinyl sulfones, vinyl
nitriles, 1-nitroethylenes or Knoevenagel condensation
products such as those, for example, of malonic
diesters and aldehydes such as formaldehyde,
acetaldehyde or benzaldehyde.

25

Some of the preferred silanes (I) are available
commercially. The Michaellike addition products can be
prepared in a simple way under the reaction conditions
described in US 5,364,955 for γ -functional
30 aminosilanes.

The moisture-curing composition further comprises at
least one aminosilane **AS2**. This aminosilane accelerates
the curing of the composition and enhances its adhesion
35 properties in the cured state. It has been found that
these effects are achieved in particular by using the
aminosilane **AS2** in the range of 0.1% - 5% by weight,
preferably 0.3% - 3% by weight, based on the overall

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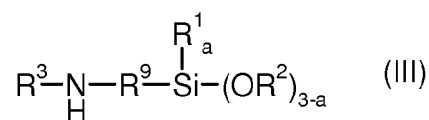
composition. It is advantageous to use only the amount of aminosilane **AS2** needed in order to achieve optimum adhesion properties, since it has been found that, in a larger amount, the aminosilane **AS2** may lower the
5 extensibility of the cured composition. Based on 100 parts by weight of polymer **A**, the aminosilane **AS2** is present typically in an amount of 0.3 to 10 parts by weight.

10 Suitable aminosilanes **AS2** are aminosilanes having at least one primary amino group (NH₂ group), such as 3-aminopropylsilanes and their derivatives, for example. Particularly suitable aminosilanes **AS2** are
15 what are called diamino silanes, which have two amino groups, more preferably those which carry one primary amino group and, positioned γ to the silicon atom, a secondary amino group (NH group), such as
N-(2-aminoethyl)-3-aminopropylsilanes, for example. Particular preference is given to
20 N-(2-aminoethyl)-3-aminopropyltrimethoxysilane and N-(2-aminoethyl)-3-aminopropyltriethoxysilane.

The moisture-curing composition further comprises at least one silane-functional polymer **A**. The silane-
25 functional polymer **A** is a silane-functional polyurethane polymer **A1**, which is obtainable through the reaction of an aminosilane **AS1** with a polyurethane polymer containing isocyanate groups. This reaction is preferably conducted in a stoichiometric ratio between
30 amino groups and isocyanate groups, or with a slight excess of amino groups, so that the resulting silane-functional polyurethane polymer **A1** is entirely free from isocyanate groups.

35 Aminosilanes **AS1** for preparing such a polymer **A1** are compounds of the formula (III)

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where

R^1 , R^2 and R^3 have the definition already described,
 a is 0 is 1, and

5 R^9 is a linear or branched, optionally cyclic, alkylene group having 2 to 12 C atoms, where appropriate with aromatic fractions, and where appropriate with one or more heteroatoms, more particularly nitrogen atoms.

10 Examples of suitable aminosilanes **AS1** are 3-aminopropyltrimethoxysilane, 3-aminopropyldimethoxymethylsilane, N-butyl-3-aminopropyltrimethoxysilane, N-phenyl-3-aminopropyltrimethoxysilane, the products of the Michaellike addition reaction of
 15 3-aminopropyldimethoxymethylsilane or 3-aminopropyltrimethoxysilane with Michael acceptors such as acrylonitrile, acrylic and methacrylic esters, maleic and fumaric diesters, citraconic diesters, and itaconic diesters, examples being dimethyl and diethyl
 20 N-(3-trimethoxysilylpropyl)aminosuccinate and also the stated silanes with ethoxy groups instead of the methoxy groups on the silicon. Particularly suitable aminosilanes **AS1** are those having a secondary amino group. Preference is given to the Michaellike addition
 25 products, more particularly to diethyl N-(3-trimethoxysilylpropyl)aminosuccinate.

Suitability as a polyurethane polymer containing isocyanate groups for preparing a silane-functional
 30 polyurethane polymer **A1** is possessed by polymers which are obtainable through the reaction of at least one polyisocyanate with at least one polyol.

This reaction can be accomplished by reacting the
 35 polyol and the polyisocyanate by typical processes, at

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temperatures for example of 50°C to 100°C, where appropriate with the accompanying use of suitable catalysts, the amount of polyisocyanate introduced being such that its isocyanate groups are present in a stoichiometric excess in relation to the hydroxyl groups of the polyol. The excess of polyisocyanate is selected such that the resulting polyurethane polymer, following the reaction of all of the polyol hydroxyl groups, has a free isocyanate group content of 0.1% - 5% by weight, preferably 0.25 - 2.5% by weight, more preferably 0.3% - 1% by weight, based on the overall polymer, left. Where appropriate the polyurethane polymer may be prepared with the accompanying use of plasticizers, in which case the plasticizers used contain no isocyanate-reactive groups.

Preferred polyurethane polymers are those having the stated free isocyanate group content and obtained from the reaction of diisocyanates with high molecular weight diols in an NCO/OH ratio of 1.5/1 to 2/1.

Polyols which can be used for preparing a polyurethane polymer containing isocyanate groups include, for example, the following commercially customary polyols or any desired mixtures of them:

- polyoxyalkylene polyols, also called polyether polyols, which are polymerization products of ethylene oxide, 1,2-propylene oxide, 1,2- or 2,3-butylene oxide, tetrahydrofuran or mixtures thereof, optionally polymerized with the aid of a starter molecule having two or more active hydrogen atoms such as, for example, water, ammonia or compounds having two or more OH or NH groups such as, for example, 1,2-ethanediol, 1,2- and 1,3-propanediol, neopentyl glycol, diethylene glycol, triethylene glycol, the isomeric dipropylene glycols and tripropylene glycols, the isomeric butanediols,

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pentanediols, hexanediols, heptanediols, octanediols, nonanediols, decanediols, undecanediols, 1,3- and 1,4-cyclohexanedimethanol, bisphenol-A, hydrogenated bisphenol-A, 1,1,1-trimethylolethane, 1,1,1-trimethylolpropane, glycerol, aniline, and mixtures of the
5 aforementioned compounds. It is possible to use not only polyoxyalkylene polyols which have a low degree of unsaturation (measured in accordance with ASTM D-2849-69 and reported as milliequivalents of unsaturation per
10 gram of polyol (mEq/g)), prepared for example using what are called double metal cyanide complex catalysts (DMC catalysts), but also polyoxyalkylene polyols having a higher degree of unsaturation, prepared for example with the aid of anionic catalysts such as NaOH,
15 KOH or alkali metal alkoxides;
- polyester polyols, polyacrylate polyols, and polymethacrylate polyols.

These stated polyols have an average molecular weight
20 of 250 to 30 000 g/mol and an average OH functionality in the range from 1.6 to 3. By "molecular weight" or "molar weight" in the present document is meant always the molecular weight average M_n .

25 Particular suitability is possessed by polyoxyalkylene diols, more particularly polyoxypropylene diols.

Especially suitable are high molecular weight polyoxypropylene diols having a degree of unsaturation
30 of less than 0.02 mEq/g and having a molecular weight in the range from 4000 to 30 000 g/mol, more particularly those having a molecular weight in the range from 8000 to 20 000 g/mol.

35 A polyurethane polymer containing isocyanate groups is prepared using commercially customary polyisocyanates. Examples of suitable polyisocyanates are 2,4- and 2,6-tolylene diisocyanate (TDI) and any desired

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mixtures of these isomers, 4,4'-, 2,4'-, and 2,2'-diphenylmethane diisocyanate (MDI) and any desired mixtures of these and further isomers, 1,3- and 1,4-phenylene diisocyanate, 2,3,5,6-tetramethyl-1,4-
5 diisocyanatobenzene, 1,6-hexamethylene diisocyanate (HDI), 2-methylpentamethylene 1,5-diisocyanate, 2,2,4- and 2,4,4-trimethyl-1,6-hexamethylene diisocyanate (TMDI), 1,12-dodecamethylene diisocyanate, cyclohexane 1,3- and 1,4-diisocyanate and any desired mixtures of
10 these isomers, 1-isocyanato-3,3,5-trimethyl-5-isocyanatomethylcyclohexane (i.e. isophorone diisocyanate or IPDI), perhydro-2,4'- and -4,4'-diphenylmethane diisocyanate (HM DI), 1,4-diisocyanato-2,2,6-trimethylcyclohexane (TMCDI), m- and
15 p-xylylene diisocyanate (XDI), 1,3- and 1,4-tetramethylxylylene diisocyanate (TMXDI), 1,3- and 1,4-bis(isocyanatomethyl)cyclohexane, oligomers and polymers of the aforementioned isocyanates, and also any desired mixtures of the aforementioned isocyanates.
20 Preference is given to MDI, TDI, HDI, and IPDI.

It is not preferred for the aminosilane **AS1** used to prepare a silane-functional polyurethane polymer **A1** to be identical to the aminosilane **AS2** that is
25 additionally present. Suitability as aminosilane **AS2** is possessed in particular by aminosilanes having a primary amino group, preferably diaminosilanes having a primary amino group and, positioned γ to the silicon atom, a secondary amino group, since it has been found
30 that the use of such aminosilanes has a particularly positive influence on the adhesion properties of the cured composition. Particularly suitable as aminosilane **AS1**, in contrast, are aminosilanes having solely a secondary amino group, since it has been found that,
35 using this kind of aminosilanes, silane-functional polyurethane polymers **A1** are obtained which are generally less viscous and, in the cured state, less brittle than when aminosilanes having primary amino

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groups are used to prepare silane-functional polyurethane polymers **A1**.

5

Not suitable as silane-functional polyurethane polymer **A1** are, in particular, polymers of the kind obtained by reacting an isocyanatosilane with a hydroxyl-containing polymer, as are described in US 4,345,053, for example.
10 Moisture-curing compositions which comprise this kind of polymers and an N-(2-aminoethyl)-3-aminopropylsilane show no significant increase in extensibility when silanes of the formula (I) are used accompanyingly.

15 Further to the silane-functional polymer **A**, the aminosilane **AS2**, and the silane (I), the moisture-curing composition of the invention may comprise further components which, however, do not adversely affect the storage stability, in other words lack the
20 capacity to trigger to a significant degree, during storage, the pro-crosslinking reaction of the silane groups present in the composition. In particular this means that such further components must contain no water or no more than traces of water. Additional
25 components may include the following auxiliaries and additives:

plasticizers, examples being esters of organic carboxylic acids or their anhydrides, such as phthalates, dioctyl phthalate or diisodecyl phthalate
30 for example, adipates, dioctyl adipate for example, and sebacates, polyols, examples being polyoxyalkylene polyols or polyester polyols, organic phosphoric and sulfonic esters or polybutenes; solvents; organic and inorganic fillers, such as ground or precipitated
35 calcium carbonates, which may have been coated with stearates, more particularly finely divided coated calcium carbonate, carbon blacks, kaolins, aluminas, silicas, PVC powders or hollow beads; fibers, of

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polyethylene for example; pigments; catalysts, examples being organotin compounds such as dibutyltin dilaurate and dibutyltin diacetylacetonate, organobismuth compounds or bismuth complexes, compounds containing amino groups, such as 1,4-diazabicyclo[2.2.2]octane and 2,2'-dimorpholinodiethyl ether, for example; rheology modifiers such as, for example, thickeners, examples being urea compounds, polyamide waxes, bentonites or fumed silicas; further adhesion promoters, epoxy silanes for example; crosslinkers, examples being silane-functional oligomers and polymers; drying agents, exemplified by vinyltrimethoxysilane, orthoformic esters, calcium oxide or molecular sieves; stabilizers against heat, light radiation and UV radiation; flame retardants; surface-active substances such as, for example, wetting agents, flow control agents, deaerating agents or defoamers; fungicides or fungal growth inhibitors; and other substances typically employed in moisture-curing compositions.

20

The moisture-curing composition preferably comprises vinyltrimethoxysilane as a drying agent. A drying agent is used in order to convert traces of moisture, which pass into the composition primarily by way of solid components such as fillers or pigments, before they can react with the silane groups of the polymer. Vinyltrimethoxysilane is an efficient and substantially more cost-effective drying agent than the α -functional silanes WO 03/014226 A1 describes. The use of vinyltrimethoxysilane in combination with the silane-functional polymers **A** leads to moisture-curing compositions having particularly good storage stability.

35

In one preferred embodiment the moisture-curing composition contains at least 0.5% by weight, more preferably at least 0.7% by weight, of vinyltrimethoxysilane, based on the overall

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composition.

Preference is given to a process for preparing a moisture-curing composition of the invention that
5 involves contacting the solid components, such as fillers and pigments, which from experience contain significant traces of moisture, with the vinyltrimethoxysilane before the silane (I) is added.

10 The moisture-curing composition described is kept in the absence of moisture. It is stable on storage, which means that in the absence of moisture it can be kept in suitable packaging or a suitable contrivance, such as a drum, a pouch or a cartridge, for example, for a period
15 ranging from several months up to a year or more, without undergoing alteration to any service-relevant extent in its application properties or in its properties after curing.

20 With regard to the application of the moisture-curing composition described, the surface of at least one arbitrary solid or article is contacted wholly or partly with the composition. Preference is given to uniform contacting in the form of an adhesive or a
25 sealant, a coating or a covering. It may well be the case that, prior to the contacting, the solid(s) or article(s) to be contacted must be subjected to a physical and/or chemical pretreatment, as for example by abrading, sandblasting, brushing or the like, or by
30 treatment with cleaners, solvents, adhesion promoters, adhesion promoter solutions or primers, or the application of a tie coat or a sealer.

When the moisture-curing composition described is
35 applied to at least one solid or article, the silane groups of the polymer and of the silanes come into contact with moisture. The silane groups have the capacity to undergo hydrolysis on contact with

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moisture. In doing so they form organosilanols (organosilicon compounds containing one or more silanol groups, Si-OH groups) and, by means of subsequent condensation reactions, form organosiloxanes (organosilicon compounds containing one or more siloxane groups, Si-O-Si groups). As a result of these reactions the composition ultimately cures; this process is also referred to as crosslinking. Alternatively, the water needed for the curing reaction can come from the air (atmospheric humidity), or else the composition can be contacted with a water-containing component, by being spread-coated, for example, with a smoothing agent, or by being sprayed, or else the composition during application can have a water-containing component added to it, in the form for example of a hydrous paste, which is mixed in by way of a static mixer, for example.

In the cured state, the moisture-curing composition described has a surprising high extensibility and at the same time possesses good storage stability, high reactivity, good adhesion properties, and a high tensile strength. As compared with an analogous composition containing no silane of the formula (I), it has a significantly higher extensibility with properties that are otherwise of comparable quality.

Surprisingly it has been found that the extensibility of the moisture-curing composition which comprises a silane-functional polymer **A** and an aminosilane **AS2**, such as N-(2-aminoethyl)-3-aminopropyltrimethoxysilane, for example, is significantly increased through the accompanying use of 0.6 - 5.0 parts by weight, preferably 0.6 - 3.5 parts by weight, of a silane (I), based on 100 parts by weight of polymer **A**. If, in contrast, α -functional silanes having three alkoxy groups on the silicon, of the kind mentioned in the examples in WO 03/014226 A1, or γ -functional

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organodialkoxysilanes are used instead of the α -functional organodialkoxysilanes represented in formula (I), then no significant increase is observed in the extensibility for compositions in the cured state.

Where less than 0.6 part by weight of a silane (I) is used, based on 100 parts by weight of polymer **A**, the increase in extensibility is too slight to exert any relevant influence on the properties of an elastic adhesive, an elastic sealant or a coating. Where more than 3.5 parts by weight, in particular more than 5.0 parts by weight, of a silane (I) are used, based on 100 parts by weight of polymer **A**, the extensibility in the cured state is not increased further; instead, the tensile strength falls significantly, which is undesirable for the use of the above-described compositions as an elastic adhesive, elastic sealant or coating.

The moisture-curing composition described cures rapidly on contact with moisture. In the cured state it possesses a high mechanical strength in tandem with a surprisingly high extensibility, and also possesses good adhesion properties. It is suitable for use as an elastic adhesive, elastic sealant or coating. More particularly it is suitable for applications which impose exacting requirements on the extensibility, at the same time as exacting requirements in terms of strength, adhesion properties, and reactivity. Examples of such applications are adhesives, sealants or coatings in industrial manufacture or repair or in civil engineering or construction or the interior fitment of means of transport or built structures. Specific mention is made of applications as an elastic adhesive in the context of the manufacturer of water or land vehicles, preferably automobiles, buses, trucks, trains or ships, and also applications as an elastic

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sealant in the context of the manufacturer of means of transport or built structures.

5 When the moisture-curing composition described is used as an adhesive, sealant or coating, there are different processes that can be employed in principle.

10 One embodiment provides a method of adhesively bonding two substrates **S1** and **S2**, which comprises the following steps:

- applying the composition to the surface of the substrate **S1**;
- contacting the surface of the substrate **S2** with the composition which is disposed on the substrate **S1**;
- 15 - and curing the composition by contact with moisture.

20 The substrates **S1** and **S2** here may be alike or different from one another.

A further embodiment provides a method of sealing which comprises the following steps:

- applying the composition between the surfaces of two substrates **S1** and **S2**;
- 25 - and curing the composition by contact with moisture.

30 The substrates **S1** and **S2** here may be alike or different from one another.

A further embodiment provides a method of adhesive bonding or of sealing in which at least one of the substrates, **S1** or **S2** - apart from any cleaning carried out with a solvent - is not pretreated by a chemical or physicochemical method. In particular no primer is applied.

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A further embodiment provides a method of adhesive

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bonding or of sealing in which at least one of the substrates **S1** or **S2**, is a metal or a metal alloy, more particularly steel, aluminum, a nonferrous metal or a galvanized metal.

5

Examples of suitable substrates **S1** or **S2** are inorganic substrates such as, for example, glass, glass-ceramic, concrete, mortar, brick, tile, plaster, and natural minerals such as granite or marble; metals or alloys
10 such as aluminum, steel, nonferrous metals, galvanized metals; organic substrates such as wood, plastics such as PVC, polycarbonates, PMMA, polyesters, epoxy resins; coated substrates such as, for example, powder-coated metals or alloys; and also inks and paints, more
15 particularly automobile topcoats.

ExamplesDescription of test methods

5 The tensile strength, the breaking extension, the
elasticity modulus at 0% - 5% extension, and the stress
at 100% extension were determined in accordance with
DIN EN 53504 (tensioning speed: 200 mm/min) on 2 mm
films cured at 23°C and 50% relative humidity for
10 7 days and then at 40°C for 7 days.

The Shore A hardness was determined in accordance with
DIN 53505.

15 The adhesion to V2A-grade stainless steel and to eloxed
aluminum (alu elox for short) was determined as
follows: A plaque of the corresponding material (V2A
steel or eloxed aluminum) was cleaned with ethanol and
then coated, without further pretreatment, with a bead
20 of the composition under test. The plaque coated with
the bead was then stored under standard conditions
(23 ± 1°C, 50 ± 5% relative humidity) for 7 days, in
the course of which the composition underwent curing.
To test the adhesion, an incision was made into the
25 cured bead at one end, down to just above the surface
of the plaque (bond line). The incised end of the bead
was held by hand and then pulled carefully and slowly
from the plaque surface with a peeling action, in the
direction of the other end of the bead. If, in the
30 course of this peeling process, the adhesion was so
strong that the end of the bead threatened to tear off
when being pulled, a cutter was used to apply a cut
perpendicular to the direction of bead pull, down to
the bare surface of the plaque, and in this way a
35 section of the bead was detached. Cuts of this kind
were repeated, if necessary, in the course of continued
pulling, at intervals of 2 to 3 mm. In this way the
entire bead was pulled and/or cut from the plaque. The

- 20 -

adhesion was identified with "yes" if at least 75% of the adhesion area had undergone cohesive detachment. An identification "no" was awarded for the adhesion if not more than 25% of the adhesion area had undergone cohesive detachment, or if virtually the entire adhesion area had undergone adhesive detachment, and the adhesion was identified with "partial" if approximately half of the adhesion area had undergone cohesive detachment.

10

Abbreviations used in the tables

	ref.	reference
	inv.	inventive
15	comp.	comparison
	ppw	part by weight
	A1120	Silquest [®] A-1120 (GE Advanced Materials): N-(2-aminoethyl)-3-aminopropyltrimethoxysilane
	XL972	Geniosil [®] XL 972 (Wacker): (N-phenyl- aminomethyl)-dimethoxymethylsilane
20	XL924	Geniosil [®] XL 924 (Wacker): (N-cyclohexyl- aminomethyl)-diethoxymethylsilane
	XL65	Geniosil [®] X 65 (Wacker): N-(dimethoxy- methylsilylmethyl)-O-methylcarbamate
25	XL32	Geniosil [®] XL 32 (Wacker): (methacryloyl- oxymethyl)-dimethoxymethylsilane
	XL34	Geniosil [®] XL 34 (Wacker): (methacryloyloxymethyl)-diethoxymethylsilane
	XL926	Geniosil [®] XL 926 (Wacker): (N-cyclohexylamino- methyl)-triethoxysilane
30	XL63	Geniosil [®] XL 63 (Wacker): N-(trimethoxysilyl- methyl)-O-methylcarbamate
	XL33	Geniosil [®] XL 33 (Wacker): (methacryloyl- oxymethyl)-trimethoxysilane
35	A2120	Silquest [®] A-2120 (GE Advanced Materials): N-(2-aminoethyl)-3-aminopropyltrimethoxymethyl- silane
	A1110	Silquest [®] A-1110 (GE Advanced Materials):

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3-aminopropyltrimethoxysilane
A1100 Silquest[®] A-1100 (GE Advanced Materials):
3-aminopropyltriethoxysilane

5 a) Preparation of silane-functional polymers**Polymer 1**

Under a nitrogen atmosphere, 1000 g of Polyol
Acclaim[®] 12200 (Bayer; low monol polyoxypropylene diol,
10 OH number 11.0 mg KOH/g, water content about 0.02% by
weight), 43.6 of isophorone diisocyanate (IPDI;
Vestanat[®] IPDI, Degussa), 126.4 g of diisodecyl
phthalate (DIDP; Palatinol[®] Z, BASF), and 0.12 g of
15 di-n-butyltin dilaurate were heated to 90°C with
continuous stirring and were left at this temperature
until the free isocyanate group content as determined
by titrimetry had reached a level of 0.63% by weight.
Subsequently, 62.3 g of diethyl N-(3-trimethoxysilyl-
20 propyl)amino succinate were mixed in and the mixture
was stirred at 90°C for 4 hours until free isocyanate
was no longer detected by means of IR spectroscopy. The
product was cooled to room temperature and stored in
the absence of moisture (theoretical polymer
content = 89.7%).

25

Diethyl N-(3-trimethoxysilylpropyl)amino succinate was
prepared as follows: 51.0 g of 3-aminopropyl-
trimethoxysilane (Silquest[®] A-1110, GE Advanced
Materials) were introduced as an initial charge. Slowly
30 and with thorough stirring, at room temperature, 49.0 g
of diethyl maleate were added and the mixture is
stirred at room temperature for 8 hours.

Polymer 2

35

Under a nitrogen atmosphere, 1000 g of Acclaim[®] 12200
(Bayer; low monol polyoxypropylene diol, OH number
11.0 mg KOH/g, water content about 0.02% by weight),

- 22 -

36.1 of isophorone diisocyanate (IPDI; Vestanat[®] IPDI, Degussa), 292.3 g of diisodecyl phthalate (DIDP; Palatinol[®] Z, BASF), and 0.23 g of di-n-butyltin dilaurate were heated to 90°C with continuous stirring and were left at this temperature until the free isocyanate group content as determined by titrimetry had reached a level of 0.33% by weight. Subsequently, 37.7 g of diethyl N-(3-trimethoxysilylpropyl)amino succinate were mixed in and the mixture was stirred at 90°C for 4 hours until free isocyanate was no longer detected by means of IR spectroscopy. The product was cooled to room temperature and stored in the absence of moisture (theoretical polymer content = 78.6%).

Diethyl N-(3-trimethoxysilylpropyl)amino succinate was prepared as described for polymer 1.

Polymer 3 (comparison)

Under a nitrogen atmosphere, 3085.8 g of Acclaim[®] 12200 (Bayer; low monol polyoxypropylene diol, OH number 11.0 mg KOH/g, water content about 0.02% by weight), 138.3 g of 3-isocyanatopropyltrimethoxysilane (Geniosil[®] GF 40, Wacker), and 0.23 g of di-n-butyltin dilaurate were heated to 90°C with continuous stirring and were left at this temperature until free isocyanate was no longer detected by means of IR spectroscopy. The product was cooled to room temperature and stored in the absence of moisture (theoretical polymer content = 100%).

b) Preparation of adhesives

Preparation of adhesive base formulation 1 (G1)

In a vacuum mixer, 3300 g of polymer 1, 1500 g of diisodecyl phthalate (DIDP: Palatinol[®] Z, BASF), 100 g of vinyltrimethoxysilane (Silquest[®] A-171, GE Advanced Materials), 4500 g of finely divided coated chalk

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(Socal[®] U1S2, Solvay, dried), 250 g of fumed silica (Aerosil[®] 200, Degussa, dried), and 10 g of di-n-butyltinyl dilaurate were processed to a homogeneous paste which was stored in the absence of moisture.

5

**Preparation of adhesive base formulation 3 (G2)
(comparison)**

10 In a vacuum mixer, 3300 g of polymer 3, 1500 g of diisodecyl phthalate (DIDP: Palatinol[®] Z, BASF), 100 g of vinyltrimethoxysilane (Silquest[®] A-171, GE Advanced Materials), 4500 g of finely divided coated chalk (Socal[®] U1S2, Solvay, dried), 250 g of fumed silica
15 (Aerosil[®] 200, Degussa, dried), and 10 g of di-n-butyltinyl dilaurate were processed to a homogeneous paste which was stored in the absence of moisture.

Preparation of adhesives

20

In a vacuum mixer, the respective adhesive base formulation was mixed homogeneously with the silanes stated in tables 1 to 4, and the mixtures were stored in the absence of moisture.

25

Examples K1 to K10

Adhesives **K2** to **K10**, shown in table 1, each contain the same fraction of diaminosilane Silquest[®] A-1120, which is an aminosilane **AS2**, and increasing amounts of Geniosil[®] XL 972, which is a silane of the formula (I). The reference adhesive **K1** contains no silane (I).

	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10
	ref.	comp.	inv.	inv.	inv.	inv.	inv.	comp.	comp.	comp.
Adhesive G1 [ppw]	99	99	99	99	99	99	99	99	99	99
A1120 [ppw]	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
XL972 [ppw]	-	0.1	0.2	0.25	0.5	1.0	1.5	2.0	2.5	4.0
ppw silane (I)/ppw polymer	-	0.33 /100	0.66 /100	0.82 /100	1.65 /100	3.29 /100	4.94 /100	6.59 /100	8.24 /100	13.2 /100
Tensile strength [MPa]	2.8	2.8	2.9	2.9	2.9	3.4	2.9	2.3	1.9	1.6
Breaking extension [%]	360	370	400	450	480	630	640	640	640	650
Elastic modulus [MPa]	3.3	3.3	3.2	2.9	2.8	2.4	2.4	2.3	1.6	1.0
Adhesion V2A to a steel	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

Table 1 Adhesive formulations.

10

The inventive adhesives **K3** to **K7**, with an increasing amount of Geniosil[®] XL 972, exhibit a significant increase in breaking extension as compared with **K1**, the tensile strengths being at least as high, or higher, than those of **K1**. The comparison adhesive **K2**, which contains less than 0.6 part by weight of Geniosil[®]

15

- 25 -

XL 972 to 100 parts by weight of polymer **A**, exhibits no significantly increased breaking extension. The comparison adhesives **K8** to **K10**, which contain more than 5.0 parts by weight of Geniosil[®] XL 972 to 100 parts by weight of polymer **A**, do also have a high breaking extension, but the tensile strengths are lower than in the case of reference adhesive **K1**, a phenomenon which is unwanted.

10 Examples K13 and K14

The adhesives **K1**, **K5**, and **K13** to **K14**, shown in table 2, contain different adhesive base formulations which differ essentially in the polymer they include. The respective reference adhesives **K1** and **K13** contain no silane of formula (I), while the adhesives **K5** and **K14** each contain 0.5 part by weight of Geniosil[®] XL 972. The polymer 3 included in adhesive base formulation **G2** does not correspond to a silane-functional polymer **A**.

20

	K1 ref.	K5 inv.			K13 ref.	K14 comp.
Adhesive G1 [ppw]	99	99			-	-
Adhesive G2 [ppw]	-	-			99	99
A1120 [ppw]	1.0	1.0			1.0	1.0
XL 972 [ppw]	-	0.5			-	0.5
Tensile strength [MPa]	2.8	2.9			2.6	2.6
Breaking extension [%]	360	480			190	200
Elastic modulus [MPa]	3.3	2.8			5.7	5.0
Adhesion V2A to a steel	yes	yes			yes	yes

Table 2 Adhesive formulations.

From the results of table 2 it is evident that the breaking extension of the inventive adhesive **K5** is

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significantly higher than that of the respective reference adhesive **K1**, while the tensile strengths are at least as high or higher. In the noninventive adhesive **K14**, containing polymer 3, the accompanying use of Geniosil® XL 972 provides virtually no increase in breaking extension as compared with the reference adhesive **K13**.

Examples K15 to K20

10

The examples **K15** to **K20** are shown in table 3. The reference adhesives **K1**, **K15** and **K16** contain no silane of the formula (I), and **K15** likewise contains no aminosilane **AS2**. The adhesives **K7** and **K17** to **K20** each contain 0.5 part by weight of a silane of the formula (I), as shown in table 3.

15

	K15 ref.	K1 ref.	K16 ref.	K5 inv.	K17 inv.	K18 inv.	K19 inv.	K20 inv.
Adhesive G1 [ppw]	99	99	99	99	99	99	99	99
A1120 [ppw]	-	1.0	1.5	1.0	1.0	1.0	1.0	1.0
Silane [0.5 ppw]	-	-	-	XL97 2	XL92 4	XL65	XL32	XL34
Tensile strength [MPa]	2.7	2.8	2.8	2.9	3.2	3.0	2.9	3.1
Breaking extension [%]	590	360	290	480	510	430	440	470
Elastic modulus [MPa]	1.9	3.3	3.6	2.8	3.0	3.1	3.0	2.9
Adhesion V2A to a steel	no	yes	yes	yes	yes	yes	yes	yes

Table 3 Adhesive formulations.

The results of table 3 show that the inventive

- 27 -

adhesives **K5** and **K17** to **K20** exhibit significantly higher breaking extensions than the reference adhesives **K1** and **K16**, while the tensile strengths are either comparably high or higher. The reference adhesive **K15**, which contains no diaminosilane Silquest® A-1120 (= aminosilane **AS2**), does have a high breaking extension; its adhesion properties, however, are unsatisfactory.

10 Examples K21 to K26 (comparisons)

In comparative examples **K21** to **K26**, silanes were added to the adhesive base formulation **G1** that do not correspond to the formula (I). The compositions and results are shown in table 4.

	K1 ref.	K21 comp.	K22 comp.	K23 comp.	K24 comp.	K25 comp.	K26 comp.
Adhesive G1 [ppw]	99	99	99	99	99	99	99
A1120 [ppw]	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Silane (0.5 ppw)	-	XL926	XL63	XL33	A2120	A1110	A1100
Tensile strength [MPa]	2.8	2.9	2.9	2.8	2.8	2.1	2.4
Breaking extension [%]	360	380	390	380	330	190	270
Elastic modulus [MPa]	3.3	3.5	3.3	3.4	3.8	3.6	3.7
Adhesion V2A to a steel	yes	yes	yes	yes	partial	yes	yes

Table 4 Comparison adhesive formulations.

In table 4 the results of the comparison adhesives **K21** to **K26** show breaking extensions which are significantly

- 28 -

lower than the breaking extensions of the inventive adhesives **K5** and **K17** to **K20** from table 3. As compared with the reference adhesive **K1**, the breaking extensions of **K21** to **K23**, which contain α -functional trialkoxysilanes, are not significantly increased. Examples **K24** to **K26** contain γ -functional organo-dialkoxysilanes and have lower breaking extensions than the reference adhesive **K1**.

10 c) Preparation of sealants

Preparation of sealant base formulation (G3)

In a vacuum mixer, 2800 g of polymer 2, 1300 g of diisodecyl phthalate (DIDP; Palatinol[®] Z, BASF), 800 g of urea thickener, 100 g of vinyltrimethoxysilane (Silquest[®] A-171, GE Advanced Materials), 4350 g of finely divided coated chalk (Socal[®] U1S2, Solvay, dried), 600 g of silicone fluid (Dow Corning 200 Fluid, Dow Corning), and 6 g of di-n-butyltin dilaurate were processed to a homogeneous paste which was stored in the absence of moisture.

The urea thickener was prepared as follows:

25 In a vacuum mixer, 3000 g of diisodecyl phthalate (DIDP; Palatinol[®] Z, BASF) and 480 g of 4,4'-methylenediphenyl diisocyanate (Desmodur[®] 44 MC L, Bayer) were introduced as an initial charge and heated slightly. Then 270 g of monobutylamine were added slowly dropwise with vigorous stirring. The resulting paste was stirred further for an hour under reduced pressure and with cooling.

Examples D1 to D9

35

In a vacuum mixer the sealant base formulation **G3** was mixed homogeneously in each case with the silanes indicated in table 5, and the resulting mixtures were

- 29 -

stored in the absence of moisture.

	D1	D2	D3	D4	D5	D6	D7	D8	D9
	ref.	ref.	ref.	inv.	inv.	inv.	inv.	inv.	comp.
Sealant G3 [ppw]	99.3	99.3	99.3	99.3	99.3	99.3	99.3	99.3	99.3
All120 [ppw]	-	0.35	0.7	0.35	0.35	0.35	0.35	0.35	0.35
Silane (0.35 ppw)	-	-	-	XL972	XL924	XL65	XL32	XL34	A2120
Tensile strength [MPa]	1.8	1.6	1.2	1.6	1.4	1.7	1.5	1.8	1.4
Breaking extension [%]	980	750	600	910	1100	940	910	1050	700
Stress at 100% extension [MPa]	0.33	0.35	0.36	0.33	0.25	0.39	0.31	0.33	0.41
Shore A	13	23	23	20	16	22	15	18	24
Adhesion to Alu elox	no	partial	yes	yes	yes	yes	partial	yes	yes

Table 5 Sealant formulations.

5 The reference sealants **D1** to **D3** contain no silane (I). Sealants **D4** to **D8** each contain 0.35 part by weight of a silane of the formula (I). The comparison sealant **D9** contains Silquest[®] A-2120, which does not correspond to the formula (I).

10

The results show that, for the inventive sealants **D4** to **D8**, breaking extensions are measured which are significantly higher than those for the reference sealants **D2** and **D3** and for the comparison sealant **D9**.

15

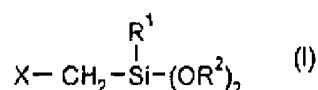
The reference sealant **D1**, which contains no diaminosilane Silquest[®] A-1120 (i.e., aminosilane **AS2**), does have a high breaking extension; its adhesion

- 30 -

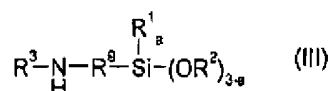
properties, however, are unsatisfactory.

Patentkrav

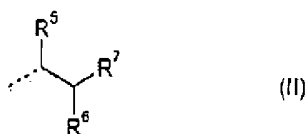
1. Fugtighedshærdende sammensætning omfattende
i det mindste en silanfunktionel polymer A, som er
en polymer A1, som fremstilles ved hjælp af omsætning af en polyurethanpolymer
5 indeholdende isocyanatgrupper med en aminosilan AS1,
i det mindste en aminosilan AS2 og
i det mindste en silan med formel (I) i en mængde på 0.6 - 5.0 vægtdele, baseret på 100
vægtdele af polymer A,



- 10 idet
R¹ står for en alkylgruppe med 1 til 8 C-atomer, navnlig for en methyl- eller for en
ethylgruppe,
R² står for en alkylgruppe med 1 til 5 C-atomer, navnlig for en methylgruppe eller for
en ethylgruppe eller for en isopropylgruppe, og
15 X står for en substituent, der er bundet via et heteroatom, idet aminosilanen AS1 har
formel (III),



- idet
R¹ og R² har den allerede beskrevne betegnelse, a står for 0 eller 1,
20 R³ står for et hydrogenatom eller for en lineær eller forgrenet carbonhydridgruppe med
1 til 20 C-atomer, som i givet fald har cykliske andele, eller for en gruppe med formel
(II),



- idet
25 R⁵ og R⁶ uafhængigt af hinanden står for et hydrogenatom eller for en gruppe fra
gruppen omfattende R⁸, -COOR⁸ og -CN, og R⁷ står for et hydrogenatom eller for en
gruppe fra gruppen omfattende -CH₂COOR⁸, -COOR⁸, -CN, -NO₂, -PO(OR⁸)₂, -SO₂R⁸
og -SO₂OR⁸, idet

- 2 -

R^8 står for en carbonhydridgruppe, som i givet fald indeholder i det mindste et heteroatom, med 1 til 20 C-atomer, og

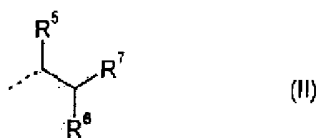
R^9 står for en lineær eller forgrenet, i givet fald cyklisk alkylengruppe med 2 til 12 C-atomer, i givet fald med aromatiske andele og i givet fald med et eller flere heteroatomer, navnlig nitrogenatomer.

2. Fugtighedshærdende sammensætning ifølge krav 1, kendetegnet ved, at silanen med formel (I) foreligger i en mængde på 0.6 - 3.5 vægtdele, baseret på 100 vægtdele af polymer A.

3. Fugtighedshærdende sammensætning ifølge krav 1 eller 2, kendetegnet ved, at substituenten X, som er bundet via et heteroatom, er en gruppe udvalgt af gruppen omfattende $-NHR^3$, $-NHCOOR^4$, $-SH$, $-OR^4$, R^4COO- , $CH_2=C(CH_3)COO-$ og $CH_2=CHCOO-$,

idet

R^3 står for et hydrogenatom eller for en lineær eller forgrenet carbonhydridgruppe med 1 til 20 C-atomer, som i givet fald har cykliske andele, eller for en gruppe med formel(II)



idet

R^5 og R^6 uafhængigt af hinanden står for et hydrogenatom eller for en gruppe fra gruppen omfattende R^8 , $-COOR^8$ og $-CN$, og

R^7 står for et hydrogenatom eller for en gruppe fra gruppen omfattende $-CH_2-COOR^8$, $-COOR^8$, $-CN$, $-NO_2$, $-PO(OR^8)_2$, $-SO_2R^8$ og $-SO_2OR^8$, idet

R^8 står for en carbonhydridgruppe, som i givet fald indeholder i det mindste et heteroatom, med 1 til 20 C-atomer,

og

R^4 står for en i givet fald substitueret carbonhydridgruppe med 1 til 20 C-atomer.

4. Fugtighedshærdende sammensætning ifølge krav 1, 2 eller 3, kendetegnet ved, at aminosilanen AS2 er en diaminosilan med en primær aminogruppe og i γ -stilling i forhold til siliciumatomet en sekundær aminogruppe.

5. Fugtighedshærdende sammensætning ifølge krav 4, kendetegnet ved, at aminosilanen AS2 er en N-(2-aminoethyl)-3-aminopropylsilan, navnlig N-(2-

aminoethyl)-3-aminopropyl-trimethoxy-silan eller N-(2-aminoethyl)-3-aminopropyl-triethoxysilan.

6. Fugtighedshærdende sammensætning ifølge et af de foregående krav, kendetegnet ved, at aminosilanen AS2 foreligger i en mængde på 0.1 - 5 vægt-%, fortrinsvis 0.3 - 3 vægt-%, baseret på den samlede sammensætning.
7. Fugtighedshærdende sammensætning ifølge et af de foregående krav, kendetegnet ved, at aminosilan AS1 er et additionsprodukt af 3-aminopropyl-trimethoxysilan eller 3-aminopropyl-dimethoxymethylsilan og Michael-acceptorer såsom maleinsyre- og fumarsyrediester, navnlig (3-trimethoxysilyl-propylamino)-ravsyredimethyl- og -diethylester samt (3-triethoxysilyl-propylamino)-ravsyredimethyl- og -diethylester.
8. Fugtighedshærdende sammensætning ifølge krav 7, kendetegnet ved, at R^3 står for en gruppe med formel (II), idet R^5 og R^7 hver især står for $-\text{COOR}^8$, R^6 står for et hydrogenatom, og R^8 står for en i givet fald forgrenet alkylgruppe med 1 til 8 C-atomer.
9. Fugtighedshærdende sammensætning ifølge krav 8, kendetegnet ved, at R^9 står for propylen, R^2 står for methyl, og a står for 0.
10. Fugtighedshærdende sammensætning ifølge et af de foregående krav, kendetegnet ved, at aminosilanen AS1 ikke er identisk med aminosilanen AS2.
11. Fugtighedshærdende sammensætning ifølge et af de foregående krav, kendetegnet ved, at sammensætningen er fri for isocyanatgrupper.
12. Fugtighedshærdende sammensætning ifølge et af de foregående krav, kendetegnet ved, at sammensætningen indeholder vinyltrimethoxysilan.
13. Udhærdet sammensætning, kendetegnet ved, at en fugtighedshærdende sammensætning ifølge et af kravene 1 til 12 er udhærdet via en reaktion med vand.
14. Anvendelse af en fugtighedshærdende sammensætning ifølge et af kravene 1 til 12 som klæbestof, tætningsmasse eller belægning.
15. Anvendelse ifølge krav 14 som klæbestof, tætningsmasse eller belægning i den industrielle fremstilling eller reparation eller i bygge- og anlægsvirksomhed eller indvendig færdiggørelse af transportmidler eller bygningsværker.
16. Fremgangsmåde til sammenklæbning af substrater S1 og S2 omfattende trinnene - applikation af en sammensætning ifølge et af kravene 1 til 12 på overfladen af substratet S1,

- tilvejebringelse af kontakt mellem overfladen på substratet S2 og sammensætningen, som er placeret på substratet S1,
 - udhærdning af sammensætningen ved kontakt med fugt, idet substraterne S1 og S2 er ens eller forskellige fra hinanden.
- 5 17. Fremgangsmåde til tætning omfattende trinnene
- applikation af en sammensætning ifølge et af kravene 1 til 12 mellem overfladerne på et substrat S1 og et substrat S2,
 - udhærdning af sammensætningen ved kontakt med fugt, idet substraterne S1 og S2 er ens eller forskellige fra hinanden.
- 10 18. Fremgangsmåde ifølge krav 16 eller 17, kendetegnet ved, at i det mindste et af substraterne S1 eller S2, bortset fra en i givet fald gennemført rensning med et opløsningsmiddel, ikke forbehandles med en kemisk eller fysisk-kemisk fremgangsmåde, navnlig at der ikke appliceres nogen primer.
- 15 19. Fremgangsmåde ifølge et af kravene 16 til 18, kendetegnet ved, at i det mindste et af substraterne S1 eller S2 er et metal eller en metallegering, navnlig stål, aluminium, et non-ferro metal eller et forzinket metal.
- 20 20. Sammenklæbet artikel, som fremstilles ved hjælp af en fremgangsmåde til sammenklæbning ifølge krav 16 eller 18 eller 19.
- 20 21. Sammenklæbet artikel ifølge krav 20, kendetegnet ved, at artiklen er et transportmiddel, navnlig et fartøj til vands eller til lands, fortrinsvis en automobil, en bus, en lastbil, et tog eller et skib eller en del heraf.
22. Tætnet artikel, som fremstilles ved hjælp af en fremgangsmåde til tætning ifølge et af kravene 17 til 19.
- 25 23. Tætnet artikel ifølge krav 22, kendetegnet ved, at artiklen er et transportmiddel eller et bygningsværk.