

DESCRIPTION

ORGANOSILANE AQUEOUS SOLUTION AND PRESERVATION METHOD THEREOF

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TECHNICAL FIELD

[0001] The present invention relates to an organosilane aqueous solution and a preservation method thereof.

10 BACKGROUND ART

[0002] In recent years, interests in sanitation and antimicrobial action have been increased with regard to living environment, including household products, clothing, and the like. In particular, due to the advent of aging society, it is desired to reduce the risk of infection and secondary infection by subjecting articles or the like used in living
15 environment, such as towels and masks, to antimicrobial and antiviral treatment to improve environment of nursing or the like, or as a simple measure to inactivate pathogenic viruses, such as influenza virus and norovirus. Therefore, many antimicrobial agents in forms of spray, which is convenient for use, or the like have been marketed.

20 [0003] In response to such needs, antimicrobial agent compositions and antiviral agent compositions containing a silicon-containing compound, which is a silane coupling agent, have been developed (see Patent Documents 1 to 4). Mixtures in which these compositions are diluted with ethanol and water can exhibit antimicrobial and antiviral effects for a long period of time since, when coated on an object, the silane coupling agent in the composition is fixed to the object. These are significantly
25 excellent compared to conventional antimicrobial agents and are practically used.

[0004] However, since silane coupling agents are typically precipitated as a result of condensation polymerization after undergoing hydrolysis, there is a disadvantage in that the solution can be cloudy or gelled. When the silane coupling agent is under such
30 conditions, in addition to the fact that the expected effect cannot be exhibited, other defects such that an injection nozzle is plugged in a product form like a spray-type product are concerned. Considering the preservation period from after the production until the use, it is necessary to suppress the cloudiness or gelling for a long period of time, i.e., over several months, under temperature environments that are expected
35 during preservation.

[0005] As measures to such defects, adding an amphoteric/cationic surfactant to an

antimicrobial agent composition solution (see Patent Documents 1 and 2), adjusting pH to the range of 2.0 to 3.5 (see Patent Document 3), adding a water-soluble organic quaternary ammonium compound and a cationic surfactant (see Patent Document 4), adjusting pH to the range of 2.0 to 3.0 using an acid such as hydrochloric acid or acetic acid and then adding glycol ether and a cationic surfactant (see Patent Document 5), and the like have been taken.

PRIOR ART DOCUMENT

Patent Documents

10 [0006] Patent Document 1: Japanese Patent Application Kokai Publication No. 2011-98976

Patent Document 2: WO2010/073825

Patent Document 3: Japanese Patent Application Kokai Publication No. 2007-31290

15 Patent Document 4: Japanese Patent Application Kohyo Publication No. H06-505036

Patent Document 5: Japanese Patent Application Kohyo Publication No. 2009-528326

20 SUMMARY OF THE INVENTION

Problems to be Solved by the Invention

[0007] However, these measures are not enough to suppress the cloudiness or gelling in a long period of time, over several months, and in particular, these measures are not effective in high temperature or low temperature regions. Furthermore, the conditions with the pH of 2.0 to 3.5 are not preferable from the perspective of use environment, considering the possibility of corrosion of the object, effects on the human body, and the like. Therefore, an object of the present invention is to provide an organosilane aqueous solution in which cloudiness or gelling can be suppressed over several months, i.e., an organosilane aqueous solution having excellent long-term preservation stability, under temperature environments that are expected during normal preservation or the like; and a preservation method thereof.

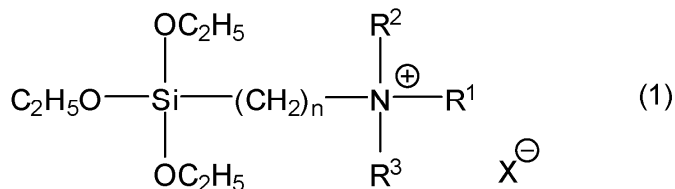
Means for Solving the Problems

[0008] The present inventions that have been completed to solve the above problems are as follows.

<1> An organosilane aqueous solution containing: a compound of general

formula (1) below; at least one type of acid selected from the group consisting of lactic acid and acetic acid; and ethanol.

General formula (1):



- 5 wherein n is an integer of 1 to 10, R¹ is an alkyl group having 10 to 30 carbons, R² and R³ are each independently an alkyl group having 1 to 6 carbons, and X⁻ is a halogen ion.

[0009] <2> The organosilane aqueous solution according to <1>, where the content of the compound of general formula (1) is 0.001% by mass to 0.8% by mass.

- 10 [0010] <3> The organosilane aqueous solution according to <1> or <2>, where pH is 4.0 to 7.0.

[0011] <4> The organosilane aqueous solution according to any one of <1> to <3>, where the content of the acid is 10 ppm to 100 ppm relative to the total mass of the organosilane aqueous solution.

- 15 [0012] <5> The organosilane aqueous solution according to any one of <1> to <4>, where the acid is lactic acid.

[0013] <6> The organosilane aqueous solution according to any one of <1> to <5>, where the organosilane aqueous solution is stable for 6 months or longer under a temperature condition of -30°C to 50°C.

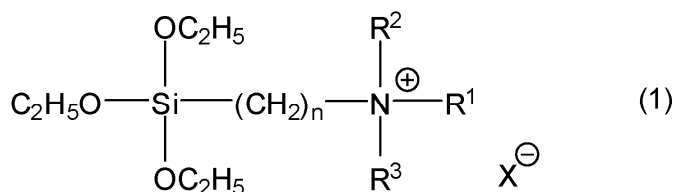
- 20 [0014] <7> The organosilane aqueous solution according to any one of <1> to <6>, where the compound of general formula (1) above is octadecyldimethyl(3-triethoxysilylpropyl)ammonium chloride.

[0015] <8> A method of preserving the organosilane aqueous solution according to any one of <1> to <7>, comprising:

- 25 adding at least one type of acid selected from the group consisting of lactic acid and acetic acid to a mixture containing a compound of general formula (1) below, ethanol and water, and

preserving it under a temperature condition of -30°C to 50°C.

General formula (1):



wherein n is an integer of 1 to 10, R¹ is an alkyl group having 10 to 30 carbons, R² and R³ are each independently an alkyl group having 1 to 6 carbons, and X⁻ is a halogen ion.

5 Effect of the Invention

[0016] Since the organosilane aqueous solution of the present invention can suppress cloudiness or gelling over a long period of time from the production to the use and has excellent long-term preservation stability, the organosilane aqueous solution can maintain its function for a long period of time when used as an antimicrobial agent,
10 antiviral agent, and the like.

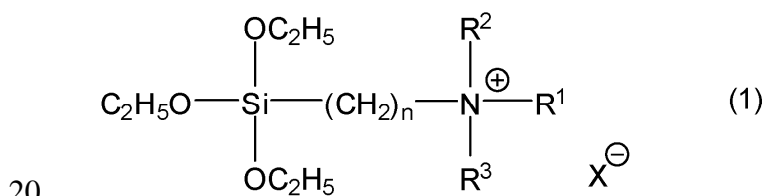
MODE FOR CARRYING OUT THE INVENTION

[0017] The present invention will be described below in detail.

[0018] Organosilane aqueous solution

15 The organosilane aqueous solution of the present invention (hereinafter, also referred to as "the aqueous solution") contains, as its essential components, a compound of general formula (1) below (hereinafter, also referred to as "the organosilane compound"):

[0019]



(wherein n is an integer of 1 to 10, R¹ is an alkyl group having 10 to 30 carbons, R² and R³ are each independently an alkyl group having 1 to 6 carbons, and X⁻ is a halogen ion),

at least one type of acid selected from the group consisting of lactic acid and acetic acid,
25 and ethanol. By allowing the organosilane compound, lactic acid and/or acetic acid, and ethanol to be contained in water which is a solvent, the aqueous solution is unlikely to cause cloudiness or gelling even after being preserved under temperature environments that are expected during preservation, i.e., freezing/refrigeration temperatures, room temperature, high temperature conditions to some extent, and the
30 like, for a long period of time, and thus has excellent long-term preservation stability.

[0020] Note that "excellent long-term preservation stability" indicates conditions where the aqueous solution contained in a hermetic container does not cause cloudiness or gelling and stays clear, or conditions where a cloudy or gelled component that is

caused is not precipitated after the aqueous solution is preserved for 3 months or longer, preferably 6 months or longer, even more preferably 1 year or longer, and yet even more preferably 2 years or longer, at -30°C to 50°C, and preferably at -16°C to 40°C. Note that the temperature condition during preservation needs to be a temperature in the temperature range described above at which the aqueous solution is stable for the period of time described above. Compared to conventional products, the aqueous solution can significantly extend the period that can maintain preservation stability, and this effect can be achieved in a wide range of temperatures as described above. Therefore, the aqueous solution can prevent degradation of quality of products over a long period of time under preservation environments that are expected from the time of production to the time of use.

[0021] Each of the components contained in the aqueous solution will be described below.

[0022] Organosilane compound

The organosilane compound contained in the aqueous solution is represented by formula (1) above. In formula (1) above, n is an integer of 1 to 10. R¹ is an alkyl group having 10 to 30 carbons. R² and R³ are each independently an alkyl group having 1 to 6 carbons. X⁻ is a halogen ion.

[0023] The organosilane compound of formula (1) has a triethoxysilane structure and a quaternary ammonium salt structure. This quaternary ammonium salt structure is the same structure as those of quaternary ammonium salts contained in typical hand disinfectants, and has antimicrobial and antiviral effects and the like. Meanwhile, since the triethoxysilane structure part chemically binds and fixes to a material (glass, wood, metal, fiber, and the like), the surface of an object to which the aqueous solution is applied is covered by the structure part having the antimicrobial and antiviral effects and the like, and thus the antimicrobial and antiviral effects can be maintained for a certain period of time. Note that "antimicrobe (antimicrobial)" indicates sterilizing or damaging bacteria and fungi or preventing proliferation of these, and "antivirus (antiviral)" indicates inactivation of pathogenic viruses. Furthermore, "fixing" indicates chemical bonding of the organosilane compound caused by the action of the silane coupling agent of the organosilane compound when the aqueous solution is applied to an object which the antimicrobial/antiviral properties are imparted.

[0024] In formula (1) above, n is an integer of 1 to 10, preferably 1 to 6, and more preferably 2 to 4.

[0025] In formula (1) above, R¹ is an alkyl group having 10 to 30 carbons. From the perspective of the antimicrobial/antiviral properties exhibited by the organosilane

compound, R^1 is preferably an alkyl group having 12 to 24 carbons, more preferably an alkyl group having 15 to 20 carbons, and even more preferably an octadecyl group.

Note that the alkyl group may be a straight or branched chain alkyl group or cycloalkyl group; however, from the perspective of the antimicrobial/antiviral properties, a chain alkyl group is preferable.

[0026] In formula (1) above, R^2 and R^3 are each independently an alkyl group having 1 to 6 carbons. From the perspective of the antimicrobial/antiviral properties exhibited by the organosilane compound, R^2 and R^3 are preferably an alkyl group having 1 to 4 carbons, more preferably a methyl group or ethyl group, and even more preferably a methyl group.

[0027] In formula (1) above, X^- is a halogen ion, and is preferably F^- , Cl^- , Br^- , or I^- , and more preferably Cl^- .

[0028] As the organosilane compound of formula (1) above, octadecyldimethyl(3-triethoxysilylpropyl)ammonium chloride is preferable.

[0029] The content of the organosilane compound in the aqueous solution is preferably 0.0001% by mass to 0.9% by mass, more preferably 0.001% by mass to 0.8% by mass, and even more preferably 0.005% by mass to 0.6% by mass. By adjusting the content of the organosilane compound to be within the numerical range described above, both the long-term preservation stability and the antimicrobial/antiviral properties of the aqueous solution can be achieved.

[0030] Acid

The aqueous solution contains at least one type of acid selected from the group consisting of lactic acid and acetic acid. By allowing the aqueous solution to contain the acid, cloudiness and gelling can be suppressed even during long-term preservation, and the aqueous solution exhibits excellent long-term preservation stability. In conventional technologies in which pH is adjusted to 2 to 3 using hydrochloric acid or the like, corrosion of an applied surface, effects on the human body, and the like are concerned. With the aqueous solution containing lactic acid and/or acetic acid, even when pH is adjusted to weakly acidic to around neutral, specifically to the range of pH of 4.0 to 7.0, the aqueous solution containing lactic acid and/or acetic acid can sufficiently suppress cloudiness and gelling and exhibits excellent long-term preservation stability in a wide range of temperatures from freezing/refrigeration temperature conditions to a certain degree of high temperature conditions. On the other hand, with an organosilane aqueous solution in which an acid other than the lactic acid and acetic acid, e.g., citric acid or the like, was added, there was a disadvantage in that cloudiness and gelling readily occurred when such an organosilane aqueous solution

was preserved, particularly, under a freezing temperature condition for a long period of time. Furthermore, when boric acid was added, cloudiness and gelling occurred in approximately two months, and there was a problem in stability, particularly, in high temperature regions. Since the aqueous solution exhibits sufficient long-term
5 preservation stability even when the pH is set to weakly acidic to around neutral, the aqueous solution is advantageous in that there are less concern on corrosion of an applied surface, effects on the human body, and the like.

[0031] The aqueous solution may contain either one of lactic acid or acetic acid or may contain both of these; however, from the perspective of maintaining preservation
10 stability for a long period of time under various temperature conditions, the aqueous solution preferably contains only lactic acid.

[0032] The concentration of the acid in the aqueous solution is not particularly limited, and the effect of long-term preservation stability can be achieved with a small amount of the acid. The concentration thereof is preferably 5 ppm to 200 ppm,
15 preferably 10 ppm to 100 ppm, and more preferably 15 ppm to 50 ppm, relative to the total mass of the aqueous solution.

[0033] Ethanol

The aqueous solution contains ethanol. The ratio of the ethanol to water in the aqueous solution is not particularly limited, and the ratio in terms of mass ratio is
20 ethanol:water = 40:60 to 80:20, and preferably ethanol:water = 70:30 which is considered to exhibit the best sterilizing/disinfection performance. Note that "water" in the aqueous solution is not particularly limited, and for example, water such as tap water, industrial water such as water for industrial use, ion-exchanged water, pure water, and the like can be used. Among these, ion-exchanged water is preferable.

[0034] The aqueous solution may contain, for example, an additive stipulated in Ethanol Business Act (e.g., methanol, isopropanol, perfume, and the like) and the like as necessary in addition to the essential components described above, or may be formed as a pH buffer solution by adding a salt corresponding to the above-described acid to be
25 added.

[0035] The pH of the aqueous solution is preferably 4.0 to 7.0, more preferably 4.0 to 6.8, and even more preferably 4.3 to 6.6, from the perspective of enhancing the long-term preservation stability in a wide range of temperatures and from the perspective of placing less concern on corrosion of an applied surface, effects on the human body, and the like.
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[0036] Method of producing organosilane aqueous solution

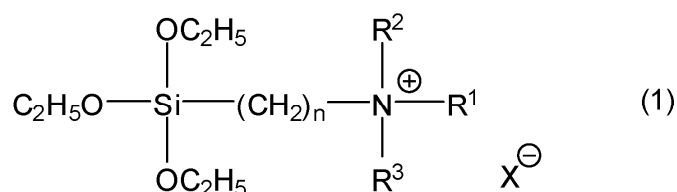
The method of producing organosilane aqueous solution of the present

invention is not particularly limited, and the organosilane aqueous solution of the present invention can be obtained by mixing and dissolving the organosilane compound, ethanol, lactic acid and/or acetic acid, and water in any order. As the production method, for example, lactic acid and/or acetic acid is added to ethanol and water while the ethanol and the water are being mixed and agitated at room temperature, and then the organosilane compound is added thereto. The organosilane aqueous solution of the present invention can be obtained by continuing the agitation until all the raw materials are sufficiently and uniformly mixed and dissolved.

[0037] Method of preserving organosilane aqueous solution

The method of preserving the organosilane aqueous solution of the present invention include adding at least one type of acid selected from the group consisting of lactic acid and acetic acid to a mixture containing a compound of general formula (1) below, ethanol, and water, and preserving it under a temperature condition of -30°C to 50°C.

General formula (1):



wherein n is an integer of 1 to 10. R¹ is an alkyl group having 10 to 30 carbons. R² and R³ are each independently an alkyl group having 1 to 6 carbons. X⁻ is a halogen ion.

EXAMPLES

Although examples of the present invention will be specifically described below, the present invention is not limited to the description of the examples. Note that abbreviations in the examples are as described below.

ESi-QAC: compound of formula (1) above, and the compound name is octadecyldimethyl(3-triethoxysilylpropyl)ammonium chloride

Examples 1 to 15

An organosilane aqueous solution was produced in accordance with the following operation. Note that the used amount of each of the components, mass ratio of ethanol:ion-exchanged water, concentration of ESi-QAC and concentration of acid in the produced aqueous solution, pH of the produced aqueous solution are shown in Tables 1 to 3.

Ethanol (Wako Pure Chemical Industries, Ltd.) and ion-exchanged water

were charged in a beaker at room temperature and stirred and mixed using a magnetic stirrer. While the mixing was continued, lactic acid or acetic acid (both from Wako Pure Chemical Industries, Ltd.) was added, and then ESi-QAC (Manac Incorporated) was added. Thereafter, stirring and mixing were performed for approximately one hour to obtain a colorless, clear organosilane aqueous solution.

[0041] Comparative Examples 1 to 5

An organosilane aqueous solution was produced in accordance with the following operation. Note that the used amount of each of the components, mass ratio of ethanol:ion-exchanged water, concentration of ESi-QAC and concentration of acid in the produced composition, pH of the produced aqueous solution are shown in Tables 2 and 3.

[0042] Ethanol (Wako Pure Chemical Industries, Ltd.) and ion-exchanged water were charged in a beaker at room temperature and stirred and mixed using a magnetic stirrer. While the mixing was continued, ESi-QAC (Manac Incorporated) was added. Thereafter, stirring and mixing were performed for approximately one hour to obtain a colorless, clear organosilane aqueous solution. Note that, in Comparative Examples 2 to 4, a predetermined amount of acid was added before adding the ESi-QAC.

[0043] [Table 1]

		Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7	Example 8
Ethanol	g	70	70	70	70	70	70	70	70
Ion-exchanged water	g	30	30	30	30	30	30	30	30
Esi-QAC	g	0.3	0.5	1.01	1.01	0.3	0.5	1.01	1.01
Mass concentration of acid	Lactic acid	mg	4.3	4.3	4.3	20			
	Acetic acid	mg					4.3	4.3	4.3
	Citric acid	mg							20
Ethanol : Ion-exchanged water	Mass ratio	70 : 30	70 : 30	70 : 30	70 : 30	70 : 30	70 : 30	70 : 30	70 : 30
Mass concentration of Esi-QAC	% by mass	0.3	0.5	1.0	1.0	0.3	0.5	1.0	1.0
Mass concentration of acid	ppm	43	43	43	198	43	43	43	198
pH after production		5.3	5.5	6.6	5.0	6.1	6.8	6.7	5.8

[0044] [Table 2]

			Example 9	Example 10	Example 11	Example 12	Example 13	Comparative Example 1
Ethanol	g		46	46	46	46	46	46
Ion-exchanged water	g		54	54	54	54	54	54
Esi-QAC	g		0.09	0.09	0.09	0.09	0.09	0.09
Mass concentration of acid	Lactic acid	mg	2.0	4.3	8.6			
	Acetic acid	mg				2.0	8.6	
	Citric acid	mg						
Ethanol : Ion-exchanged water	Mass ratio		46 : 54	46 : 54	46 : 54	46 : 54	46 : 54	46 : 54
Mass concentration of Esi-QAC	% by mass		0.09	0.09	0.09	0.09	0.09	0.09
Mass concentration of acid	ppm		20	43	86	20	86	0
pH after production			4.5	4.4	4.3	5.1	5.4	7.2

[0045] [Table 3]

			Example 14	Example 15	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5
Ethanol	g		70	70	70	70	70	70
Ion-exchanged water	g		30	30	30	30	30	30
Esi-QAC	g		0.5	0.5	0.5	0.5	0.5	0.5
Mass concentration of acid	Lactic acid	mg		0.2				
	Acetic acid	mg	0.2					
	Citric acid	mg			0.2			
	Hydrochloric acid	mg				0.2		
	Boric acid	mg					0.2	
Ethanol : Ion-exchanged water	Mass ratio		70 : 30	70 : 30	70 : 30	70 : 30	70 : 30	70 : 30
Mass concentration of Esi-QAC	% by mass		0.50	0.50	0.50	0.50	0.50	0.50
Mass concentration of acid	ppm		20	20	20	20	20	0
pH after production			7.0	6.6	6.7	3.9	7.8	7.7

5 [0046] Preservation stability test

Preservation stability test was performed for organosilane aqueous solutions obtained in Examples 1 to 15 and Comparative Examples 1 to 5. The test method and test conditions will be described. In a colorless, transparent glass media bottle having a capacity of approximately 20 mL, approximately 20 mL each of the test samples was charged, capped, and sealed. During the charging, filtration by gravity was performed using a filter cloth of 200 mesh to remove impurities in the liquid. The test sample was preserved under temperature conditions at -16°C, 4°C, room temperature (varied within

the range of 10°C to 30°C), and 40°C, and the change in appearance was visually observed. The test results are shown in Tables 4 to 6. Note that the test results were evaluated by the following method and shown in tables. Furthermore, "n.d." in the tables indicates "not determined".

5 O: Clear

×: Cloudiness or gelling occurred, or cloudy or gelled components precipitated

[0047] [Table 4]

Period of preservation	Temperature of preservation	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Example 7	Example 8
Within 1 month	-16°C	O	O	×	×	O	O	×	×
	4°C	O	O	n.d.	n.d.	O	O	n.d.	n.d.
	Room temperature	O	O	O	O	O	O	O	O
	40°C	O	O	O	O	O	O	O	O
3 months	-16°C	O	O	×	×	O	O	×	×
	4°C	O	O	n.d.	n.d.	O	O	n.d.	n.d.
	Room temperature	O	O	O	×	O	O	O	×
	40°C	O	O	O	O	O	O	O	O
6 months	-16°C	O	×	O	×	O	O	×	×
	4°C	O	O	n.d.	n.d.	O	×	n.d.	n.d.
	Room temperature	O	O	×	×	O	O	×	×
	40°C	O	O	O	O	O	O	O	O

10 [0048] [Table 5]

Period of preservation	Temperature of preservation	Example 9	Example 10	Example 11	Example 12	Example 13	Comparative Example 1
Within 1 month	-16°C	O	O	O	O	O	O
	4°C	O	O	O	O	O	O
	Room temperature	O	O	O	O	O	O
	40°C	O	O	O	O	O	×
3 months	-16°C	O	O	O	O	O	O
	4°C	O	O	O	O	O	O
	Room temperature	O	O	O	O	O	O
	40°C	O	O	O	O	O	×
6 months	-16°C	O	O	O	O	O	×
	4°C	O	O	O	O	O	O
	Room temperature	O	O	O	O	O	×
	40°C	O	O	O	O	O	×

[0049] [Table 6]

Period of preservation	Temperature of preservation	Example 14	Example 15	Comparative Example 2	Comparative Example 3	Comparative Example 4	Comparative Example 5
Within 1 month	-16°C	○	○	○	○	○	×
	40°C	○	○	○	○	×	○
3 months	-16°C	○	○	×	○	×	×
	40°C	○	○	○	○	×	×
6 months	-16°C	○	○	×	×	×	×
	40°C	○	○	○	○	×	×

[0050] When the preservation stability test was performed for an even longer period of time for the organosilane aqueous solutions of Examples 1 and 5, the organosilane aqueous solutions were clear under all the temperature conditions at -16°C, 4°C, room temperature, and 40°C even after 2 years.

[0051] As shown in Tables 4 to 6, it was confirmed that the organosilane aqueous solutions according to the present invention exhibit significantly excellent long-term preservation stability under each of the preservation temperature conditions. As shown in Table 6, it was confirmed that the organosilane aqueous solutions of the present invention exhibit superior preservation stability for longer period of time, in particular, superior preservation stability under a freezing temperature condition, compared to the organosilane aqueous solutions of comparative examples in which an acid other than the acetic acid and lactic acid was added.

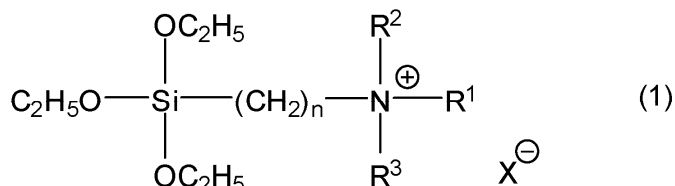
INDUSTRIAL APPLICABILITY

[0052] The organosilane aqueous solution of the present invention can suppress cloudiness or gelling over a long period of time from the production to the use, and has excellent long-term preservation stability. Therefore, the organosilane aqueous solution of the present invention is advantageously used as antimicrobial agents, antiviral agents, and the like, in particular, in a form of spray which is convenient for use or the like. The organosilane aqueous solution of the present invention can impart antimicrobial properties or antiviral properties to surfaces of various materials, such as metals, glass, ceramics, resins, and fibers, with a simple process without polluting environment, and exhibits excellent long-term preservation stability. Therefore, the organosilane aqueous solution can be suitably used in the fields where antimicrobial and antiviral effects are required, such as medical field and food field.

CLAIMS

1. An organosilane aqueous solution comprising: a compound of general formula (1) below, at least one type of acid selected from the group consisting of lactic acid and acetic acid, and ethanol;

general formula (1):



wherein, n is an integer of 1 to 10, R¹ is an alkyl group having 10 to 30 carbons, R² and R³ are each independently an alkyl group having 1 to 6 carbons, and X⁻ is a halogen ion.

2. The organosilane aqueous solution according to claim 1, wherein the content of the compound of general formula (1) is 0.001% by mass to 0.8% by mass.

3. The organosilane aqueous solution according to claim 1 or 2, wherein pH is 4.0 to 7.0.

4. The organosilane aqueous solution according to any one of claims 1 to 3, wherein the content of the acid is 10 ppm to 100 ppm relative to the total mass of the organosilane aqueous solution.

5. The organosilane aqueous solution according to any one of claims 1 to 4, wherein the acid is lactic acid.

6. The organosilane aqueous solution according to any one of claims 1 to 5, wherein the organosilane aqueous solution is stable for 6 months or longer under a temperature condition of -30°C to 50°C.

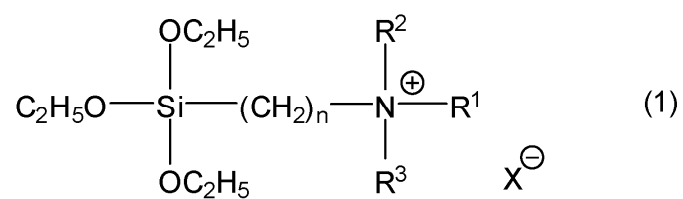
7. The organosilane aqueous solution according to any one of claims 1 to 6, wherein the compound of general formula (1) is octadecyldimethyl(3-triethoxysilylpropyl)ammonium chloride.

8. A method of preserving the organosilane aqueous solution according to any one of claims 1 to 7, comprising:

adding at least one type of acid selected from the group consisting of lactic acid and acetic acid to a mixture containing a compound of general formula (1) below, ethanol and water, and

preserving it under a temperature condition of -30°C to 50°C;

general formula (1):



wherein, n is an integer of 1 to 10, R¹ is an alkyl group having 10 to 30 carbons, R² and R³ are each independently an alkyl group having 1 to 6 carbons, and X⁻ is a halogen ion.