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(54) Title: CONTAINER SEALANT COMPOSITION

(57) Abstract: Disclosed is a container sealant composition with improved can sealing performance and reduced hot water absorption. The composition comprises a latex of a carboxylated styrene-butadiene rubber, a filler (preferably kaolin clay), an organosilane, and a tackifier. Also disclosed is a method of sealing a can with the aforescribed container sealant composition.

Container Sealant Composition

Background of the Invention

[0001] The present invention relates to a container sealant composition with improved can sealing performance and reduced hot water absorption.

[0002] Container sealant compositions based on a rubbery polymer, such as styrene-butadiene rubber (SBR) and carboxylated styrene-butadiene rubber (CSBR) are well known in the art. In order to obtain acceptable water resistance, extrusion resistance and container seam performance, such compositions often include a crosslinking agent, such as a peroxide or zinc compound, to form a crosslinked network within the rubber component. Such sealant compositions also typically include a filler and a tackifier. Examples of such sealant compositions are disclosed in US 4,189,418, WO 82/02721, EP 0182674, US 5,747,579, and US 8,211,254. However, the aforementioned patents do not suggest that organosilane would be useful with respect to container sealant compositions.

[0003] In US 5,763,388 there is suggested a method of making aqueous compatibilized silica slurry that may be more readily blended with a rubber latex. Fumed silica and precipitated silica are mentioned for the silica dispersion. The aqueous compatibilized silica slurry is made by treating the silica dispersion with an organosilane coupling agent that includes a reactive functional group. It is suggested that this treatment allows the incorporation of greater quantities of compatibilized silica slurry in the rubber polymer. However, this patent does not suggest that the organosilane would be useful with respect to carboxylated rubbers or that it would be useful with respect to container sealant compositions.

[0004] In US 6,756,079 and US 8,029,906 there are suggested compositions and methods for treating metal substrates with aminosilanes. These aminosilane coatings protect the metal substrate from corrosion and form a

base for adhering rubber-like polymeric compositions to the metal. However, these patents do not suggest that organosilanes would be useful with respect to carboxylated rubbers or with respect to container sealant compositions.

Summary of the Invention

5 [0005] The present invention embraces a container sealant composition comprising a latex of a carboxylated styrene-butadiene rubber (CSBR), a filler, an organosilane, and a tackifier. The filler may be selected from the group consisting of clay, particularly kaolin clay, precipitated silica, silica gel, titanium dioxide, calcium carbonate, alumina white, calcium sulfate,
10 aluminum hydroxide, talc, and a combination of two or more of these materials. Preferably, the filler comprises kaolin clay.

[0006] The present invention also includes a method for sealing a can. The method comprises coating an aqueous dispersion of the container sealant composition according to the present invention onto the curl area of a can cap,
15 drying the composition, placing the coated can cap onto a can body filled with contents, and sealing the can by seaming the flange area of the can body and the curl area of the cap to obtain a sealed can containing the contents. The method may additionally include subjecting the sealed can to a heat treatment to sterilize the contents.

20 Detailed Description of the Invention

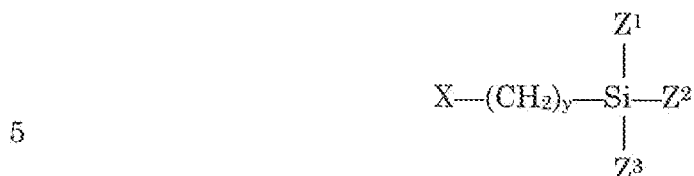
[0007] The container sealant composition of the present invention comprises a latex of a carboxylated styrene-butadiene rubber (CSBR). The CSBR may be any of those conventionally used to form container sealant compositions. Typical CSBR's are disclosed in US 5,747,579 and include
25 copolymers of styrene and butadiene with a carboxylic acid such as fumaric acid, acrylic acid, methacrylic acid, itaconic acid, aconitic acid, maleic acid or corotonic acid or with an anhydride such as maleic anhydride or itaconic anhydride. A preferred CSBR is a copolymer of styrene and butadiene with acrylic acid. Generally, the amount of acid (or anhydride) copolymerized with
30 the styrene-butadiene will be about 0.5% to 6% by weight of the elastomer.

The proportion of styrene and butadiene will typically range from 30% to 70% for each component, based on 100 parts of styrene plus butadiene (i.e., 30 to 70 phr (phr = parts per hundred parts rubber)). Typically, the amount of butadiene is about 35% to 55%, while the amount of styrene is about 45% to 65%. Typically, the CSBR has a gel content of 0 to 70 wt.%, a Mooney viscosity of 30 to 150 (ML₁₊₄, 100°C) and a styrene content of 20 to 60 wt.%. The CSBR latex will typically comprise about 40% to 70% total rubber solids.

[0008] The container sealant composition additionally includes a filler. The filler preferably is selected from the group consisting of clay, particularly kaolin clay, precipitated silica, silica gel, titanium dioxide, calcium carbonate, alumina white, calcium sulfate, aluminum hydroxide, talc, and a combination of two or more of these materials. Preferably, the filler comprises kaolin clay. Typically, the composition will include about 5 to 80 parts by weight of filler per 100 parts by weight of CSBR (i.e., 5 to 80 phr), preferably about 10 to 50 parts by weight of clay filler per 100 parts by weight of CSBR (i.e., 10-50 phr). This results in a CSBR to clay ratio of 100:5 to 100:80, preferably 100:10 to 100:50. Preferably, the container sealant composition is substantially free (i.e., less than 0.5%, preferably less than 0.1%, by weight), most preferably completely free, of colloidal silica.

[0009] The container sealant composition additionally includes an organosilane. The organosilane includes a functional group that will react with the carboxyl group in CSBR to build a network structure in the rubber system. It is theorized that formation of such a network structure provides reduced hot water absorption and improved can sealing performance without the need for a crosslinking agent. Thus, in a preferred embodiment, the container sealant composition is substantially free (i.e., less than 0.1% by weight), most preferably completely free, of crosslinking agent. The amount of the organosilane can be varied within relatively wide limits, e.g., 1 to 15 parts of organosilane per 100 parts by weight of filler (e.g., clay), preferably 3 to 10 parts by weight of organosilane per 100 parts by weight of filler.

[0010] Suitable organosilanes include those having the general formula



wherein X is a functional group selected from the group consisting of an amino group, a polyamino alkyl group, a mercapto group, a polysulfide group, an epoxy group, a hydroxy group, a vinyl group, an acryloxy group and a methacryloxy group; y is 0 to 8, preferably 2 to 6; and Z¹, Z² and Z³ are each independently selected from the group consisting of hydrogen, C₁ to C₁₈ alkyl, aryl such as phenyl, benzyl and the like, cycloalkyl such as cyclopentyl, cyclohexyl, etc., or aryl, alkoxy or halo substituted alkyl, and C₁ to C₈ alkoxy group, with the proviso that at least one of Z¹, Z² or Z³ must be one of the foregoing alkoxy groups or one of the Z's must be a halogen, hydroxyl, or hydrogen group.

[0011] Representative of such organosilanes that are commercially available include 3-aminopropyltrimethoxysilane, 3-aminopropyltriethoxysilane, 3-aminopropyldimethylethoxysilane, 3-aminopropyldihydroxymethoxysilane, N-(2-aminoethyl)-3-aminopropyltrimethoxysilane, N-(2-aminoethyl)-3-aminopropyldiethoxysilane, N-methyl-aminopropyltrimethoxysilane, 3-hydroxypropyltripropoxysilane, 3-mercaptopropyltriethoxysilane, glycidylpropyltrimethoxysilane, 3-methacryloxypropyltriethoxysilane, 3-methacryloxypropyltrimethoxysilane, 2-mercaptoethyltriethoxysilane, 3-thiocyanatopropyltriethoxysilane, bis-(3-triethoxythiopropyl) tetrasulfide, vinyltriethoxysilane, vinylphenylmethylsilane, vinyl dimethylmethoxysilane, divinyl dimethoxysilane, divinylethyldimethoxysilane, dimethylvinylchlorosilane, and the like. Preferred organosilanes are the amino-organosilanes, and particularly preferred are 3-aminopropyltriethoxysilane and N-(2-aminoethyl)-3-aminopropyltrimethoxysilane. Preferably, the organosilane is added to the composition after the filler has been added.

[0012] The container sealant composition preferably additionally includes a tackifier. The tackifier may be selected from any those commonly used in container sealant compositions. Generally, the tackifier may include at least one material selected from the group consisting of rosin-based resins (e.g.,
5 rosin, hydrogenated rosin, rosin ester, hydrogenated rosin ester), terpene-based resins (e.g., α -pinene, β -pinene, dipentene), phenol-formaldehyde-based resins and petroleum hydrocarbon-based resins. The amount of the tackifier included in the composition may be varied, but will typically be included in an amount of about 10 to 150 parts, preferably 15 to 100 parts, by weight per 100
10 parts by weight (solids) of the rubber component (i.e., 10 to 150 phr, preferably 15 to 100 phr).

[0013] When the filler comprises kaolin clay, the container sealant composition may also comprise an additional filler. Such additional filler may be at least one material selected from the group consisting of silica, titanium
15 dioxide, calcium carbonate, alumina white, calcium sulfate, aluminum hydroxide and talc. The amount of the additional filler may be varied, but will typically be included in an amount of about 5-150 parts by weight per 100 parts by weight (solids) of the rubber component (i.e., 5 to 150 phr).

[0014] The container sealant composition may also include minor amounts
20 of other additives such as colorants (e.g., carbon black), antioxidants, thickeners (e.g., bentonite, karaya gum, methyl cellulose), bactericides, surfactants, and pH adjusters.

[0015] The above-described container sealant composition is advantageously used to seal a can. Generally, the method comprises coating
25 an aqueous dispersion of the container sealant composition onto the curl area of a can cap, drying the composition, placing the coated can cap onto a can body filled with contents, and sealing the can by seaming the flange area of the can body and the curl area of the cap to obtain a sealed can containing the contents. The method may additionally include subjecting the sealed can to a
30 heat treatment to sterilize the contents. The sealant composition of the

present invention provides improved can sealing performance, thus forming a better seal, as well as reduced hot water absorption.

Example 1

[0016] This example demonstrates the improvements resulting from the container sealant compositions of the present invention. The organosilane (when present) is added slowly, while stirring, into kaolin clay dispersed CSBR latex in the amounts shown in Table 1, then these mixtures are stirred for 15 to 20 minutes at 200 to 300 rpm. The remaining ingredients are added to this dispersion, which is stirred for one hour then defoamed under vacuum. The results are shown in Table 1.

Table 1

Ingredient	Amount (parts by weight)				
	A	B	C	D	E ⁴
Organosilane ¹	1.8	0	1.8	0	0
CSBR (solid) ²	100	100	100	100	
SBR (solid)					100
Kaolin Clay	30	30	30	30	30.3
Stabilizer ³	0	0	1.2	1.2	1.2
Other ingredients (incl. tackifier)	39	39	39	39	89
Hot water absorption of dried film					
Immersion for 1 minute (%)	1.1	3.0	6.5	10.3	16.6
Immersion for 3 minutes (%)	2.7	5.3	7.5	18.1	30.0
Can pack test results					
Number of cans with leakage after impact (n=100)	0	8	5	11	15

¹ N-(2-aminoethyl)-3-aminopropyltrimethoxysilane (KBM603; ShinEtsu)

² XQ 83286.01 (50% CSBR solids; Siam Synthetic Co., Ltd)

³ Styrene Maleic Anhydride Copolymer (Scripset 540; Hercules)

⁴ WBC103S-2 (Typical Japanese water based sealant available from W.R. Grace)

[0017] A typical water based container sealant composition (E) shows high water absorption, 16.6% and 30.0%, in dried films after immersing in hot water (> 90°C) respectively for 1 and 3 minutes. The hot water absorption of composition (E) is reduced to 10.3% and 18.1% in composition (D) by the

replacement of SBR by CSBR and formula simplification. In addition, the hot water absorption of composition (D) is reduced significantly to 1.1% and 2.7% by stabilizer elimination and addition of organosilane in composition (A). It can be seen that addition of organosilane to other formulations (A from B, and
 5 C from D) also contributes to improved can sealing performance.

Example 2

[0018] A container sealant composition is prepared having the ingredients listed below.

	<u>Ingredient</u>	<u>Dry Weight (PHR)</u>
10	CSBR ¹	100
	Aluminum silicate (Kaolin clay) ²	30
	Amino-organosilane ³	1.8
	Titanium dioxide	5
	Tackifier ⁴	30
15	Thickener ⁵	2.16
	Carbon black	0.3
	Dispersant ⁶	0.34
	Antioxidant ⁷	1

20 ¹ XQ 83286.01 (50% CSBR solids; Siam Synthetic Co., Ltd)

² Buca Clay filler (BASF Catalyst)

³ N-(2-aminoethyl)-3-aminopropyltrimethoxysilane (KBM603; ShinEtsu)

⁴ Blend of Aqueous Dispersion of Polymerized Rosin Ester (10 phr Foralaxe from Eastman Chemical), Hydrogenated Ester Rosin (20 phr Forelyn 5020-F from Eastman Chemical)

25 ⁵ Methyl cellulose (1.76) and Karaya gum (0.4)

⁶ Naphthalene sulfonic acid, formaldehyde, Na (0.1) and Sodium Carbonate (0.24)

⁷ Tetrakis methylene di-tert-butylhydroxycinnamate methyl

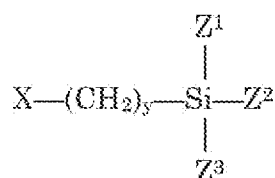
[0019] The amino-organosilane is added slowly, while stirring, into clay dispersed CSBR latex, then these mixtures are stirred for 15 to 20 minutes at
 30 200 to 300 rpm. The remaining ingredients are added to this dispersion, which is stirred for one hour then defoamed under vacuum.

[0020] The above-described composition is used to seal a can in the conventional manner. The aqueous dispersion of sealant composition is

coated onto the curl area of a can end (or can cap) using a reciprocal liner and heat-dried in an air circulating oven at 90°C for ten minutes. A 190 ml can is filled with hot liquid (e.g., boiled water to simulate food contents), then the can end is placed on the filled can and seamed using a reciprocal double
5 seamer. The seamed can is then subjected to heat sterilization (e.g., 125°C for 30 min.), then allowed to cool to room temperature. The can exhibits substantially improved can sealing performance.

Claims

1. A container sealant composition comprising a latex of a carboxylated styrene-butadiene rubber (CSBR), a filler, an organosilane, and a tackifier wherein the weight ratio of CSBR to filler ranges from 100:5 to 100:80.
2. The container sealant composition according to claim 1, wherein the filler is selected from the group consisting of clay, kaolin clay, precipitated silica, silica gel, titanium dioxide, calcium carbonate, alumina white, calcium sulfate, aluminum hydroxide, talc, and a combination of two or more of these materials
3. The container sealant composition according to claim 1, wherein the filler comprises kaolin clay.
4. The container sealant composition according to claim 1, wherein the weight ratio of CSBR to filler ranges from 100:10 to 100:50
5. The container sealant composition according to any of claims 1 to 4, wherein the organosilane has the general formula



wherein X is a functional group selected from the group consisting of an amino group, a polyamino alkyl group, a mercapto group, a polysulfide group, an epoxy group, a hydroxy group, a vinyl group, an acryloxy group and a methacryloxy group; y is 0 to 8, preferably 2 to 6; and Z¹, Z² and Z³ are each independently selected from the group consisting of hydrogen, C₁ to C₁₈ alkyl, aryl such as phenyl, benzyl and the like, cycloalkyl such as cyclopentyl, cyclohexyl, etc., or aryl, alkoxy or halo substituted alkyl, and C₁ to C₈ alkoxy group, with the proviso that at least one of Z¹, Z² or Z³ must be one of the

foregoing alkoxy groups or one of the Z's must be a halogen, hydroxyl, or hydrogen group.

6. The container sealant composition according to claim 5, wherein the organosilane is selected from the group consisting of 3-aminopropyltrimethoxysilane, 3-aminopropyltriethoxysilane, 3-aminopropyldimethylethoxysilane, 3-aminopropyldihydroxymethoxysilane, N-(2-aminoethyl)-3-aminopropyltrimethoxysilane, N-(2-aminoethyl)-3-aminopropyltriethoxysilane, and N-methyl-aminopropyltrimethoxysilane.

7. The container sealant composition according to claim 5, wherein the organosilane is N-(2-aminoethyl)-3-aminopropyltrimethoxysilane.

8. The container sealant composition according to any preceding claim, wherein the amount of organosilane is 1 to 15 parts by weight of organosilane per 100 parts by weight of filler.

9. The container sealant composition according to any preceding claim, wherein the tackifier is at least one member selected from the group consisting of rosin-based resins, terpene-based resins, phenol-formaldehyde-based resins, and petroleum hydrocarbon-based resins and the amount of the tackifier is 10-150 parts by weight per 100 parts by weight of the rubber component.

10. The container sealant composition according to claim 3, comprising an additional filler, wherein the additional filler comprises at least one material selected from the group consisting of silica, titanium dioxide, calcium carbonate, alumina white, calcium sulfate, aluminum hydroxide and talc, and wherein the amount of the additional filler is 5-150 parts by weight per 100 parts by weight of the rubber component.

11. The container sealant composition according to any preceding claim, wherein the carboxylated styrene-butadiene rubber has a gel content of 0 to

70 wt.%, a Mooney viscosity of 30 to 150 (ML₁₊₄, 100°C) and a styrene content of 20 to 60 wt.%.

12. The container sealant composition according to any preceding claim, wherein the composition is substantially free of crosslinking agent.

13. The container sealant composition according to any preceding claim, wherein the composition is substantially free of colloidal silica.

14. A method for sealing a can which comprises coating an aqueous dispersion of the container sealant composition according to any preceding claim onto the curl area of a can cap, drying the composition, placing the coated can cap onto a can body filled with contents, and sealing the can by seaming the flange area of the can body and the curl area of the cap to obtain a sealed can containing the contents.

15. The method according to claim 14 additionally comprising subjecting the sealed can to a heat treatment to sterilize the contents.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 13/76409

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - C08L 83/00 (2014.01)

USPC - 524/588; 524/492; 525/479

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(8) - C08L 83/00 (2014.01)

USPC - 524/588

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC: 524/492; 525/479 (search terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase (AU BE BR CA CH CN DE DK EP ES FI FR GB IN JP KR SE TH TW US WO), PubWest, Free Patents Online, Google Web
search terms: container sealant tackifier filler kaolin clay carboxylated styrene-butadiene rubber CSBR organosilane (2-aminoethyl)-3-aminopropyltrimethoxysilane aminopropyltrimethoxysilane aminopropyltriethoxysilane

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2010/0163156 A1 (Kishi et al.) 01 July 2010 (01.07.2010), para [0009], [0010], [0012], [0026], [0029]; Table 1	1-7, 10
Y	US 5,747,579 A (Blakeman et al.) 05 May 1998 (05.05.1998), col 2, ln 53-55; col 2, ln 56-60	1-7, 10
Y	US 2002/0077420 A1 (Chiba et al.) 20 June 2002 (20.06.2002), para [0005], [0009], [0017], [0033], [0034], [0038], [0039]	1-7, 10
Y	US 2009/0184157 A1 (Sisler et al.) 23 July 2009 (23.07.2009), para [0026], [0029], [0031]-[0032]	7
Y	US 2007/0173597 A1 (Williams et al.) 26 July 2007 (26.07.2007), para [0017], [0052], [0055]-[0056]	1-7, 10
Y	US 2002/0049282 A1 (Obrecht et al.) 25 April 2002 (25.04.2002), para [0007]-[0008], [0010], [0027], [0029]-[0039], [0045]-[0046]	1-6
Y	US 2008/0293872 A1 (Loth et al.) 27 November 2008 (27.11.2008), para [0005], [0006], [0073], [0111]-[0116], [0126], [0146], [0150]-[0151], [0154], [0161]	1-4
X, P	WO 2013/096360 A1 (Qi et al.) 27 June 2013 (27.06.2013), para [0006]-[0011], [0015]-[0016], [0021]	1-7, 10

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

* Special categories of cited documents:

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

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

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

"O" document referring to an oral disclosure, use, exhibition or other means

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

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

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

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family.

Date of the actual completion of the international search

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Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 13/76409

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 8-9 and 11-15
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.