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(71) Applicant: **ARCHROMA IP GMBH** [CH/CH]; Neuhofstr. 11, 4153 Reinach (CH).

(72) Inventors: **MAYER DE OLIVEIRA, Jorge**; Avenida Jorge Bei Maluf, 2175, 08686-000 Suzano – SP (BR).
CORPET, Damien Julien; 9 C rue du Galois, 71380 Oslon (FR).

(74) Agent: **WALLINGER RICKER SCHLOTTER TOST-MANN PATENT- UND RECHTSANWÄLTE PARTNERSCHAFT MBB**; Zweibrückenstraße 5 - 7, 80331 Munich (DE).

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(54) Title: COMPOSITIONS FOR PROVIDING BARRIER PROPERTIES FOR PAPER, CARDBOARD AND TEXTILE

(57) Abstract: Compositions for providing barrier properties like liquid-, and/or oil-, and/or grease-resistant properties to a substrate, preparations and applications as well as therefrom substrates and articles, as for example food containers, plates, straws, bags (from paper and textile), cloths and bowls. It was found that substrates treated with said composition possess improved properties in terms of liquid-, grease- and oil-resistance even after subsequent folding steps as for example in following folding steps to obtain food-containers.

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Compositions for providing barrier properties for Paper, Cardboard and Textile

FIELD OF THE INVENTION

[0001] The invention relates to compositions comprising a copolymer comprising styrene units and acrylic ester units and a styrene maleic anhydride copolymer, the manufacturing method and use of these compositions for providing barrier properties, like oil-barrier, liquid-barrier, and/or grease-barrier, and/or heat sealing properties to a substrate like paper, cardboard or textile.

BACKGROUND OF THE INVENTION

[0002] Packaging has become an essential element in food purchases. The food is packed with the aim of being transported and stored. The packaging of food products is part of the marketing and distribution process.

[0003] The principal roles of food packaging are to protect food products from outside influences and damage. Plastics are the most common and most wide-ranging materials used for food packaging. Of the plastics used food packaging, polyolefins and polyester are the most common materials.

[0004] In recent years, as a result of a global environmental concern, plastic pollution has attracted worldwide attention. Plastic wastes not only disrupt ecosystems and biodiversity, but they also threaten human life and health. Therefore, packaging industry must move out to plastic packaging for more recyclable solution.

[0005] Following this trend, paper and paperboard packaging has become an alternative to this increasing demand of a sustainable and more environmentally friendly material and in this way the development of better solutions for a renewable, recyclable packaging.

[0006] Although paper and paperboard are an alternative to this demand of a more sustainable packaging materials, they don't have the needed barrier properties to provide protection against water, grease, oil and other substances. Paper and paperboard have

very low barrier properties, as the material is very porous and thus having a high permeability. Paper and paperboard consist of cellulosic fibres, extracted from trees, combined with additives to make a continuous matted web, and thus forming the structure of the material. Paperboard is a relatively thicker and heavier material than paper. It is widely used as secondary packaging that is not generally in direct contact with the food. Its main use is for packaging and containers in the form of boxes.

[0007] To be a viable replacement, however, the barrier properties of paperboard need to be improved. The first step has been to develop paper and textile-based packaging using fibers treated with fluorochemicals. But fluorochemicals are now under pressure, as suspected to be persistent in the environment. There is still a need for a more sustainable solution than fluorochemicals. Polyethylene (PE) has also dominated as a barrier coating in packaging applications, due to its properties, especially to provide water resistance. However, packages coated with PE may be challenging to recycle at a standard recycling facility. Another concern is that PE coatings may contaminate fibers during the repulping process, prohibiting the fiber in this way from being recycled.

[0008] On the other side, for oil and grease resistance, early barrier coatings for food packaging were made from synthetic polymeric chemicals known as per- and polyfluoroalkyl substances (PFAS). PFAS are a diverse class of compounds characterized by having a hydrophobic, fluorine-saturated carbon chain joined to a hydrophilic functional group. This structure gives PFAS the ability to repel both water and fat readily. However, PFAS can't be separated from the paper easily, which means the paper can't be recycled or repulped. Besides this restriction, the whole family of compounds has also been shown to have harmful effects on human health.

[0009] Paper and Textile industries has been trying, without success until now, surface treatments using waxes, acrylic copolymers and mixtures of both; but these compositions are known to show weakness after folding and significant loss of their barriers properties. Low Tg acrylate copolymers have been tested in such applications, but their use is very limited today due to the stickiness and blocking problems created by the low Tg.

[0010] Today, on the market, there is still a need to find a replacement for plastic, a solution which keeping good barrier properties even after folding.

OBJECTS OF THE INVENTION

[0011] It is therefore the object of the invention to provide compositions which meet the above defined needs of the paper and textile industry in terms of barrier properties while no PFAS are used.

SUMMARY OF THE INVENTION

[0012] The inventors discovered that the compositions according to the invention provide good barrier properties like liquid-, grease- or oil-resistance as well as good heat-sealing properties after being applied onto the surface of a suitable substrate.

[0013] Further, it was found that said resistances provided to the substrates treated with the compositions according to the invention better withstand folding processes compared to coatings known in the prior art, i.e. said substrates showed satisfying resistances even after subsequent folding steps.

[0014] Hence, the present compositions are advantageous since after applying to substrates subsequent folding steps may be performed without loss of the resistance properties.

[0015] Accordingly, the object is solved by the compositions according to the invention:

[0016] Composition I for providing barrier properties, in particular liquid-resistant properties to a substrate according to the invention comprises at least components (A) and (B2), wherein (A) is at least one copolymer comprising the following monomer units: (A1) at least one monomer selected from styrene, methyl methacrylate, (meth)acrylonitrile, α -methyl styrene or mixtures thereof; and (A2) at least one monomer comprising acrylic acid ester units; and (B2) is at least one styrene maleic anhydride ester.

[0017] In composition I according to the invention component (A) is present in an amount in the range of from 30.0 wt% to 90.0 wt%; component (B2) is present in an amount in the range of from 2.0 wt% to 40.0 wt%; wherein the dry wt% of components (A) and (B2) add up to 100 wt%.

[0018] The method according to the invention for manufacturing the composition I according to the invention comprises at least the following step a): Performing sub-steps i., ii., optionally iii.: i.) Providing component (B2) to a first reaction area; ii.) Providing at least the monomers (A1) and (A2) to a second reaction area to obtain a monomer mixture; optionally combining the monomer mixture in the second reaction area with the mixture in the first reaction area; and copolymerizing said monomer mixture to obtain component (A); or provide component (A) directly; iii.) optionally mixing the composition obtained in step i. and/or the composition obtained in step ii. to provide a first copolymer mixture; wherein optionally in any of steps a)i., a)ii., or a)iii. one or more additional components may be added to the respective mixtures.

[0019] Composition II according to the invention for providing barrier properties to a substrate, comprises at least components (A), (B1) and/or (B2) and (C), wherein (A) is at least one copolymer comprising the following monomer units: (A1) at least one monomer selected from styrene, methyl methacrylate, (meth)acrylonitrile, α -methyl styrene or mixtures thereof; and (A2) at least one monomer comprising acrylic acid ester units; and (B1) is at least one styrene maleic anhydride copolymer and/or (B2) is at least one styrene maleic anhydride ester, and (C) is at least one elastomer and/or at least one wax, preferably at least one vegetal wax.

[0020] In the compositions according to the invention the at least one monomer (A1) is present in an amount of 20.0 to 75.0 wt%, and/or the at least one monomer (A2) is present in an amount of 25.0 to 80.0 wt%, preferably wherein the at least one monomer (A1) is present in an amount of 25.0 to 65.0 wt% and/or the at least one monomer (A2) is present in an amount of 35.0 to 75.0 wt%, optionally wherein one or more further monomers (A3) may be present the copolymer in an amount of at most 5 wt%, the copolymer comprising components (A1), (A2) and optionally (A3) equaling 100 wt%.

[0021] In the compositions according to the invention the at least one monomer (A2) is selected from alkyl acrylates or alkyl meth acrylates others than methyl methacrylate which include methyl acrylate, ethyl(meth) acrylate, butyl(meth) acrylate, iso butyl acrylate, amyl acrylate, hexyl acrylate, 2-ethylhexyl acrylate, octyl acrylate, isooctyl acrylate, decyl acrylate, dodecyl acrylates, isomers thereof, and combinations thereof;

and/or wherein the one or more further monomers (A3) are selected from (meth)acrylamide, (meth)acrylic acid, 1,3-butylene glycol dimethacrylate, 1,4-butylene glycol dimethacrylate, diethylene glycol dimethacrylate, dipropylene glycol dimethacrylate, divinyl benzene, ethylene glycol dimethacrylate, itaconic acid, N-methylol(meth)acrylamide, 4-methyl-1,4-pentanediol dimethacrylate, propylene glycol dimethacrylate, trivinyl benzene, or mixtures thereof.

[0022] In composition II according to the invention, the at least one elastomer is selected from the group ethylene/vinyl acetate, polybutadiene, natural latexes, synthetic latexes, styrene-butadiene emulsions, or mixtures thereof; preferably wherein component (C) is natural latex or polybutadiene or mixtures thereof; and/ or wherein the vegetal wax is selected from soya wax, carnauba wax, palm oil, corn hydrogenated oil, coconut hydrogenated oil, castor hydrogenated oil, rapeseed hydrogenated oil, or combinations thereof.

[0023] The compositions according to the invention can further comprise at least one further component selected from non-ionic surfactant, ionic surfactant, pH adjusting agent, preservative, dye, pigment, defoamer, thickener, waxes, wetting agent, plasticizers, or combinations thereof.

[0024] The compositions according to the invention can be dry compositions, preferably powder or granulate; or liquid compositions comprising a solvent, such as an organic solvent or water, preferably wherein the compositions according to the invention are aqueous emulsions, aqueous suspensions, aqueous solutions, aqueous slurries or a mixture thereof.

[0025] In composition II according to the invention component (A) is present in an amount in the range of from 30.0 wt% to 90.0 wt%; component (B1) and/or (B2) is present in an amount in the range of from 2.0 wt% to 40.0 wt%; component (C): the at least one elastomer is present in an amount in the range of from 1.0 wt% to 42.0 wt% and/or the at least one wax is present in an amount in the range of from 1 % to 50 wt% wherein the total dry wt% of the components (A), (B1) and/or (B2) and (C) add up to 100 wt%.

[0026] The method according to the invention of manufacturing composition II according to the invention comprises at least the following steps a) and b): a) Performing sub-steps

i., ii., optionally iii.: i.) Providing component (B1) and/or (B2) to a first reaction area; ii.) Providing at least the monomers (A1) and (A2) to a second reaction area to obtain a monomer mixture; optionally combining the monomer mixture in the second reaction area with the mixture in the first reaction area; and copolymerizing said monomer mixture to obtain component (A); or provide component (A) directly; iii.) optionally mixing the composition obtained in step i. and/or the composition obtained in step ii. To provide a first copolymer mixture; b) addition of component I to the first copolymer mixture obtained in step a); wherein optionally in any of steps a)i., a)ii., a)iii. or b) one or more additional components may be added to the respective mixtures.

[0027] Composition II according to the invention is particularly suitable to be used as barrier, in particular oil-barrier and/or grease-barrier in case (C) is at least one elastomer the composition is further used resistance to folding; in case (C) is at least one wax the composition is also used as liquid-barrier on a substrate; preferably, wherein the substrate is a cellulose based substrate, preferably paper or cardboard, or a substrate based on synthetic polymers, like nylon; or a substrate based on natural material, like wool; or a mixture of two or more of these substrates thereof.

[0028] Composition I according to the invention is particularly suitable to be used as liquid-barrier or an heat-seal on a substrate; preferably, wherein the substrate is a cellulose based substrate, preferably paper or cardboard, or a substrate based on synthetic polymers, like nylon; or a substrate based on natural material, like wool; or a mixture of two or more of these substrates thereof.

[0029] A coated substrate according to the invention comprises a coat, wherein the coat of the substrate comprises or consists of the composition I or composition II according to the invention; preferably wherein the substrate is a cellulose based substrate, preferably paper or cardboard, or a substrate based on synthetic polymers, like nylon; or a substrate based on natural material, like wool; or a mixture of two or more of these substrates thereof; preferably wherein the coated substrate further comprises an overcoat selected from humidity barriers, oxygen barriers, heat sealings, gas barriers, esthetic overcoatings such as printing, varnish or to provide gloss, or combinations thereof.

[0030] A method according to the invention of manufacturing a coated substrate according to the invention comprises the following steps: I) applying the composition according to the invention onto a substrate; II) drying the composition according to the invention on the substrate.

[0031] A manufacturing method according to the invention of an article according to the invention comprises or consists of the coated substrate according to the invention, wherein the coated substrate is subjected to measures selected from the group comprising cutting, folding, gluing, curing, dyeing, or combinations thereof.

[0032] An article according to the invention comprises or consists of the coated substrate according to the invention, wherein the article is a food or beverage container, plate, straw, bags, bowls, cloths, bags (made from paper or textile).

DETAILED DESCRIPTION OF THE INVENTION

[0033] The invention relates to a composition (in the following also referred to as "composition I") for providing barrier properties, in particular liquid-barrier properties and heat-sealing properties to a substrate, comprising at least components (A) and (B2), wherein

(A) is at least one copolymer comprising the following monomer units

(A1) is at least one monomer selected from styrene, methyl methacrylate, (meth)acrylonitrile, α -methyl styrene or mixtures thereof; and

(A2) is at least one monomer comprising acrylic acid ester units; and

(B2) is at least one styrene maleic anhydride ester.

[0034] The invention further relates to compositions (in the following referred to as "composition II") for providing barrier properties, like liquid-, and/or oil-, and/or grease-resistant properties to a substrate, comprising at least components (A), (B1) and/or (B2) and (C), wherein

(A) is at least one copolymer comprising the following monomer units

(A1) at least one monomer selected from styrene, methyl methacrylate, (meth)acrylonitrile, α -methyl styrene or mixtures thereof; and

(A2) at least one monomer comprising acrylic acid ester units;

- (B1) is at least one styrene maleic anhydride copolymer, and/or
- (B2) is at least one styrene maleic anhydride ester; and
- (C) is at least one elastomer and/or at least one wax, preferably a vegetal wax.

[0035] In case, it is only referred herein to “composition(s) according to the invention”, it is always referred to compositions I and II.

[0036] The term “barrier properties” refers to “liquid-, and/or oil- and/or grease-resistance” which refers to the properties of a substrate to withstand the absorption of liquids, vapor, grease, and/or oil into the fiber-matrix of said substrate, and thus, a loss of its stability and shape among other mechanical properties, when in direct contact with said substances. The term “liquid-barrier” means to provide a substrate with the property to withstand the absorption of liquids in general, like water, hot coffee, or acid liquids like cola as well as vapors, like water vapor. The term “liquid-barrier” can be used interchangeably with the term “water-barrier”.

[0037] The term “substrate” refers to any material which shall be provided with a liquid-, and/or oil-, and/or grease-resistance barrier and/or heat-sealing properties. The material of the substrate can be selected from a cellulose-based material, or a material based on synthetic polymers or any other natural based material, or a mixture thereof. Suitable substrates are, for example but not limited to, papers, cardboards, non-wovens or textiles. It is possible that substrates comprise or consist of cellulose fibers and/or synthetic fibers and/or fibers of other natural origin. Suitable examples are, but not limited to, cotton, polyesters, polyamides, silk, wool, or mixtures thereof. It is possible that substrate thickness varies in broad boundaries, i.e. the area weight of the substrates to be treated with the compositions according to the invention can be in the range of from 20 g/m² to 500 g/m², or from 30 g/m² to 400 g/m².

[0038] In addition, it is possible that the substrate is a thin paper having an area weight of from 30 g/m² to 80 g/m², or a thick paper having an area weight of from 80 g/m² to 110 g/m².

[0039] It is further possible that the substrate is a cardboard such as a board liner having an area weight of 110 g/m² to 180 g/m², or a thick board having an area weight of from 180 g/m² to 400 g/m².

[0040] It is also possible that the substrate is a non-woven having an area weight of from 50 g/m² to 100 g/m².

[0041] Further, it is possible that the substrate is a textile such as but not limited to a cellulose-based textile, a synthetic fiber-based textile or mixture thereof.

[0042] Further, it is possible that the substrate may or may not be (pre-)treated in any other process known to the prior art.

[0043] The term “(pre-)treated” is not meant to be limiting the invention to be used as part of another process. Although it is possible to integrate the invention into any kind of process for treating substrates to improve their liquid-, oil- or grease-resistance, as well as heat-sealing properties.

[0044] The compositions according to the invention comprise at least one copolymer as component (A) comprising or consisting of at least monomer units (A1) and (A2).

[0045] The term “copolymer” refers to any modified or unmodified, branched or unbranched polymer comprising or consisting of two or more monomer units which differ from each other.

[0046] The term “monomer” refers to a molecule being able to react with the same and/or different monomer molecules to form larger polymer chains or three-dimensional networks in polymerization reactions.

[0047] The at least one monomer (A1) of component (A) of the compositions according to the invention comprises or consists of styrene, methyl methacrylate, (meth)acrylonitrile, α -methyl styrene, or mixtures thereof. Preferred monomers (A1) are styrene, methyl methacrylate, acrylonitrile or mixtures thereof.

[0048] The at least one monomer (A1) is present in the at least one copolymer (component (A)) in an amount of at least 20.0 wt%, or at least 25 wt%, or at least 30.0 wt%, or at least 35.0 wt%, or at most 75 wt%, or at most 70 wt%, or at most 60.0 wt%, or at most 50.0 wt% or at most 45.0 wt%, or from 20.0 wt% to 75 wt%, or from 25 wt% to 65 wt%, or from 25.0 wt% to 60.0 wt%, or from 30.0 wt% to 60.0 wt%, or from 30.0 wt% to 50.0 wt%, or from 30 wt% to 45 wt%, or from 35 wt% to 60 wt%, or from 35 to 55 wt%, wherein the wt% are based on the total weight of the copolymer comprising components (A1) and (A2) equaling 100 wt%.

[0049] The at least one monomer (A2) of component (A) of the composition according to the invention comprises or consists of acrylic acid ester units $\text{CH}_2=\text{CR}^3\text{COO-R}^2$ wherein R^2 represents a residue, i.e. the alcohol moiety of the ester, containing preferably from 1 to 40 carbon atoms. In one embodiment, R^2 is a branched or unbranched or cyclic C_1 to C_{40} alkyl group that may be saturated or unsaturated. In a preferred embodiment, R^2 is selected from a branched or unbranched or cyclic C_2 to C_{20} alkyl group, preferably from a C_4 to C_{10} alkyl group. In one embodiment, R^3 is selected from the group consisting of H, CH_3 , or C_2H_5 . In a preferred embodiment, R^3 is H and R^2 is a C_{4-10} alkyl group.

[0050] The copolymer (component (A)) may comprise different monomer units (A2) which can be selected from alkyl acrylates or alkyl meth acrylates others than methyl methacrylate which include methyl acrylate, ethyl(meth) acrylate, butyl(meth) acrylate, iso butyl acrylate, amyl acrylate, hexyl acrylate, 2-ethylhexyl acrylate, octyl acrylate, isooctyl acrylate, decyl acrylate, dodecyl acrylates, isomers thereof, and combinations thereof. Particularly preferred are butyl acrylate, 2-ethylhexyl acrylate and/or isooctyl acrylate, most preferably 2-ethylhexyl acrylate, butyl acrylate or mixtures thereof, even most preferably 2-ethyl hexyl acrylate.

[0051] The at least one monomer (A2) can be present in the at least one copolymer (component (A)) in an amount of at least 25 wt%, or at least 30 wt%, or at least 35 wt%, 40.0 wt%, or at least 50.0 wt%, or at least 55.0 wt%, or at most 80 wt%, or at most 75.0 wt%, or at most 70.0 wt%, or at most 65.0 wt%, or from 25 wt% to 80 wt%, or from 35 wt% to 75 wt%, or from 30.0 wt% to 75.0 wt%, or from 45.0 wt% to 75.0 wt%, or from 40 wt% to 70 wt% or from 50.0 wt% to 70.0 wt%, or from 50.0 wt% to 65.0 wt%, or from 55 wt% to 70 wt%, wherein the wt% are based on the total weight of the copolymer comprising components (A1) and (A2) equaling 100 wt%.

[0052] It is also possible that in case the at least one monomer (A1) comprises or consists of a methyl methacrylate, the at least one monomer (A2) is a different acrylic monomer.

[0053] Further, it is possible that component (A) comprises or consists of styrene (monomer A1) and 2-ethylhexylacrylate (monomer A2).

[0054] It is further possible that component (A) comprises or consists of 20.0 wt% to 75.0 wt% of styrene (monomer A1) and 25.0 wt% to 80.0 wt% of 2-ethylhexylacrylate

(monomer A2), wherein the wt% are based on the total weight of the copolymer comprising components (A1) and (A2) equaling 100 wt%.

[0055] In addition, it is possible that component (A) comprises or consists of styrene (monomer A1) and butylacrylate (monomer A2).

[0056] Further, it is possible that component (A) comprises or consists of 20.0 wt% to 75.0 wt% of styrene (monomer A1) and 25.0 wt% to 80.0 wt% of butylacrylate (monomer A2), wherein the wt% are based on the total weight of the copolymer comprising components (A1) and (A2) equaling 100 wt%.

[0057] Further, it is possible that component (A) comprises or consists of methyl methacrylate (monomer A1) and 2-ethylhexylacrylate (monomer A2).

[0058] It is further possible that component (A) comprises or consists of 20.0 wt% to 75.0 wt% of methyl methacrylate (monomer A1) and 25.0 wt% to 80.0 wt% of 2-ethylhexylacrylate (monomer A2), wherein the wt% are based on the total weight of the copolymer comprising components (A1) and (A2) equaling 100 wt%.

[0059] In addition, it is possible that component (A) comprises or consists of methyl methacrylate (monomer A1) and butylacrylate (monomer A2).

[0060] Further, it is possible that component (A) comprises or consists of 20.0 wt% to 75.0 wt% of methyl methacrylate (monomer A1) and 25.0 wt% to 80.0 wt% of butylacrylate (monomer A2), wherein the wt% are based on the total weight of the copolymer comprising components (A1) and (A2) equaling 100 wt%.

[0061] Further, it is possible that component (A) comprises or consists of acrylonitrile (monomer A1) and 2-ethylhexylacrylate (monomer A2).

[0062] It is further possible that component (A) comprises or consists of 20.0 wt% to 75.0 wt% of acrylonitrile (monomer A1) and 25.0 wt% to 80.0 wt% of 2-ethylhexylacrylate (monomer A2), wherein the wt% are based on the total weight of the copolymer comprising components (A1) and (A2) equaling 100 wt%.

[0063] In addition, it is possible that component (A) comprises or consists of acrylonitrile (monomer A1) and butylacrylate (monomer A2).

[0064] Further, it is possible that component (A) comprises or consists of 20.0 wt% to 75.0 wt% of acrylonitrile (monomer A1) and 25.0 wt% to 80.0 wt% of butylacrylate

(monomer A2), wherein the wt% are based on the total weight of the copolymer comprising components (A1) and (A2) equaling 100 wt%.

[0065] Further, it is possible that component (A) comprises or consists of styrene and methyl methacrylate (monomer A1) and 2-ethylhexylacrylate (monomer A2).

[0066] Further, it is possible that component (A) comprises or consists of 20.0 wt% to 75.0 wt% of styrene and methyl methacrylate (monomer A1) and 25.0 wt% to 80.0 wt% of 2-ethylhexylacrylate (monomer A2).

[0067] It is further possible that the copolymer of component (A) of the composition of the invention optionally comprises one or more monomers (A3) in addition to the monomers (A1) and (A2).

[0068] Non-limiting examples for these one or more additional monomers are (meth)acrylamide, (meth)acrylic acid, 1,3-butylene glycol dimethacrylate, 1,4-butylene glycol dimethacrylate, diethylene glycol dimethacrylate, dipropylene glycol dimethacrylate, 4-methyl-1,4-pentanediol dimethacrylate, propylene glycol dimethacrylate, ethylene glycol dimethacrylate, divinylbenzene, itaconic acid, N-methylol acrylamide, N-methylol methacrylamid, trivinylbenzene or mixtures thereof.

[0069] The one or more optional monomer (A3) can be present in component (A) in an amount of at least 0.001 wt%, or at least 0.01 wt%, or at least 0.1 wt%, but in any case at most 5.0 wt%, or at most 4.0 wt% or at most 3.0 wt%, or from 0.001 wt% to 5.0 wt%, or from 0.01 wt% to 4.0 wt%, or from 0.1 wt% to 3.0 wt%, wherein the wt% are based on the total amount of the copolymer comprising components (A1), (A2) and optionally (A3) equaling 100 wt%.

[0070] Component (A) may be present in the compositions according to the invention in an amount of at least 30.0 wt%, or at least 35wt%, or at least 40.0 wt%, or at least 45.0 wt%, or at most 90.0 wt%, or at most 80.0 wt%, or at most 75.0 wt%, or from 30.0 wt% to 90.0 wt%, or from 35.0 wt% to 80.0 wt%, or from 35.0 to 75.0 wt%, or from 40.0 wt% to 80.0 wt%, or from 40.0 to 75.0 wt%, wherein the dry wt% of all components present in the compositions according to the invention add up to 100 wt%.

[0071] The molecular weight (M_n) for component (A) maybe at least 100,000 g/mol, or at least 200,000 g/mol, or at least 300,000 g/mol, or at least 400,000 g/mol, or at most

1,000,000 g/mol, or at most 900,000 g/mol, or at least 800,000 g/mol, or at least 700,000 g/mol, or may range between 100,000 to 1,000,000 g/mol, or between 200,000 to 900,000 g/mol, or between 300,000 to 800,000 g/mol. Preferred molecular weights for component (A) are between 200,000 to 900,000 g/mol, or between 300,000 to 800,000 g/mol. Molecular weight (M_n) of component (A) is measured after dissolution of component (A) into THF, at a concentration of maximum 50 g/100mL of acetone. This solution is then injected in a gel permeability chromatography, which separates the different chains according to their molecular weight. UV detector can be used.

[0072] Further, the glass transition temperature T_g of component (A) may be at least -40°C , or at least -30°C , or at least -20°C , or at most 40°C , or at most 30°C , or at most 20°C , or may range between -40°C to 40°C , or between -30°C to 30°C , or between -20°C to 30°C , or between -10°C to 30°C . T_g of component (A) is determined according to the method defined in the following with regard to component (B1).

[0073] It is possible that one or more copolymers are used as component (A) in the compositions according to the invention.

[0074] Further, it is possible that the additional copolymers of component (A) comprise or consist of the same or (partially) different monomers or is made of one or more additional monomers.

[0075] Preferably, the compositions according to the invention and/or component (A) do not contain any fluorine-based compounds, like PFAs.

[0076] Composition I according to the invention further comprises at least one styrene maleic anhydride ester as component (B2). Composition II according to the invention comprises at least one styrene maleic anhydride (SMA) copolymer as component (B1) and/or at least one styrene maleic anhydride ester as component (B2).

[0077] The advantage to use (esterified) SMA, i.e. component (B1) and/or (B2), is its ability to act as polymeric surfactant in an emulsion polymerization process, alone or in combination with other surfactants to provide enhanced liquid barrier properties as well as heat sealing properties for substrates that can be converted into beverage containers and other food containers.

[0078] Esterified styrene maleic anhydride copolymer ("e-SMA"; component (B2)) can be produced by esterifying SMA (i.e. component (B1)) through standard esterification techniques using an alcohol which is an alkyl, aryl, cycloalkyl, arylalkyl or alkylaryl monoalcohol, in particular a C2 to C20 monovalent alcohol, in particular a primary or secondary alcohol which is preferably aliphatic such as ethanol, butanol, isobutanol, propanol, isopropanol, methanol, 2-ethylhexanol, isooctanol or a mixture of these alcohols. Preferred are ethanol, butanol and isobutanol or a mixture thereof.

[0079] It is possible to use at least 80wt%, or at least 82 wt%, or at least 85 wt%, or at most 90wt%, or at most 87 wt% of SMA (i.e. component (B1)) and at least 10wt%, or at least 13 wt%, or at most 20 wt%, or at most 18 wt%, or at most 15 wt% alcohol for the esterification, wherein the wt% are based on the total amount of component (B1) and alcohol (=100wt%) used in the esterification reaction. The wt% ranges of component (B1) and alcohol used in the esterification reaction may vary from 80 wt% to 90 wt%, or 82 wt% to 90 wt%, or 85 wt% to 90 wt% of component (B1) and 10 to 20 wt%, or 10 to 18 wt%, or 10 to 15 wt% of the alcohol, wherein the wt% are based on the total amount of component (B1) and alcohol (=100wt%) used in the esterification reaction.

[0080] Component (B2) as used in the compositions according to the invention can be selected from SMA methyl, ethyl or (sec- or iso-) butyl esters. Such copolymers may contain p-nitrostyrene as a polymerization chain terminator.

[0081] Esterified styrene-co-maleic-anhydride have molecular weights (M_n) which is at least 1000 g/mol, or at most 80,000 g/mol, or at most 50,000 g/mol, or at most 25,000 g/mol, or at most 10,000 g/mol, or at most 9,500 g/mol, or is in the range of from 1,000 g/mol to 80,000 g/mol, or from 1,000 g/mol to 50,000 g/mol, or from 1,000 g/mol to 25,000 g/mol, or from 1,000 g/mol to 10,000 g/mol.

[0082] The esterified styrene maleic anhydride copolymer has a glass transition temperature (T_g) from about 75°C and 130°C, preferably from 90 °C to 130 °C, even more preferred from 95 to 120°C. T_g is measured as disclosed herein with regard to component (B1).

[0083] It is possible that component (B2) is present in composition I according to the invention in an amount of at least 2.0 wt%, or at least 4.0 wt%, or at least 5.0 wt%, or at

least 10.0 wt%, or at most 40.0 wt%, or at most 35 wt%, or at most 30 wt%, or at most 28.0 wt%, or at most 27.5 wt%, or at most 26.0 wt% or in the range of from 2.0 wt% to 40.0 wt%, or from 4.0 wt% to 28.0 wt%, or from 5.0 wt% to 27.5 wt%, or from 10.0 wt% to 26 wt%, wherein the dry wt% of the components (A) and (B2) add up to 100 wt%.

[0084] It is possible that components (B1) and/or (B2) are present in composition II according to the invention in an amount of at least 2.0 wt%, or at least 4.0 wt%, or at least 5.0 wt%, or at least 10.0 wt%, or at most 40.0 wt%, or at most 35 wt%, or at most 30 wt%, or at most 28.0 wt%, or at most 27.5 wt%, or at most 26.0 wt% or in the range of from 2.0 wt% to 40.0 wt%, or from 4.0 wt% to 28.0 wt%, or from 5.0 wt% to 27.5 wt%, or from 10.0 wt% to 26 wt%, wherein the dry wt% of the components (A), (B1) and/or (B2) and (C) add up to 100 wt%.

[0085] It is also possible that components (B1)/(B2) of the compositions according to the invention at least comprise or consist of a varying maleic anhydride and styrene content.

[0086] Further, it is possible that the content of maleic anhydride monomer in the SMA copolymer of component (B1) / (B2) is at least 20.0 wt%, or at least 21.0 wt%, or at least 22 wt%, or at least 25 wt%, or at most 35.0 wt%, or at most 33.0 wt%, or vary in a range of from 20.0 wt% to 35.0 wt%, or in a range of 21.0 to 35.0 wt%, or in a range of 25.0 wt% to 35.0 wt%, wherein the wt% are based on the total weight of component (B1) or (B2) equaling 100 wt%.

[0087] It is also possible that the content of the styrene monomer in the SMA polymer of component (B1) / (B2) is at least 60.0 wt%, or at least 62 wt%, or at least 65 wt%, or at least 73.0 wt%, or at most 80.0 wt%, or at most 79.0 wt%, or at least 75.0 wt%, or be vary in a range of from 60.0 wt% to 80.0 wt%, or in the range of 65.0 wt% to 79.0 wt%, or in a range of 65.0 wt% to 75.0 wt%, wherein the wt% are based on the total weight of component (B1) or (B2) equaling 100 wt%.

[0088] It is possible that the molecular weight (M_n) of component (B1) is at least 1000 g/mol, or at most 80,000 g/mol, or at most 50,000 g/mol, or at most 25,000 g/mol, or at most 10,000 g/mol, or at most 9,500 g/mol, or is in the range of from 1,000 g/mol to 80,000 g/mol, or from 1,000 g/mol to 50,000 g/mol, or from 1,000 g/mol to 25,000 g/mol, or from 1,000 g/mol to 10,000 g/mol. Molecular weight (M_n) of (B1) or (B2) are measured after

dissolution of (B1) or (B2) powder into acetone and/or THF, at a concentration of maximum 50 g/100mL of acetone. This solution is then injected in a gel permeability chromatography, which separates the different chains according to their molecular weight. UV detector can be used.

[0089] It is further possible that the Tg of component (B1) is at least 85 °C or at least 100 °C, or at least 115 °C, or at most 180 °C, or at most 165 °C. or at most 150 °C, or varies in a range of from 85 °C to 180 °C, or from 100°C to 165°C, or from 115°C to 150 °C, or from 115 °C to 165 °C, or from 115 °C to 130°C, or from 110°C to 150°C, or from 100 °C to 150 °C. Tg of components (B1) or (B2) are measured using DSC method (Differential Scanning Calorimetry), measurement starts at -85°C and until 200°C, heating is done with a ramp during 15 minutes.

[0090] Particularly suitable SMAs to be used as component (B1) in composition II according to the invention contain 25.0 to 35.0 wt% maleic anhydride and 65.0 to 75.0 wt% of styrene, wherein the wt% are based on the total weight of component (B1) (=100 wt%) and/or have a molecular weight in the range of 1,000 g/mol to 10,000 g/mol and/or have a glass transition temperature of between 110°C to 150°C, preferably 115 to 130°C.

[0091] Particularly suitable e-SMAs to be used as component (B2) in composition I according to the invention contain 25.0 to 35.0 wt% maleic anhydride and 65.0 to 75.0 wt% of styrene, wherein the wt% are based on the total weight of component (B2) (=100 wt%), is esterified using ethanol, butanol, isobutanol or a mixture thereof, wherein the wt% of SMA is 80wt% to 90 wt% and 10 to 20 wt% of alcohol, wherein the wt% are based on the total amount of SMA and alcohol (=100wt%) used in the esterification reaction, and/or have a molecular weight in the range of 1,000 g/mol to 10,000 g/mol and/or have a glass transition temperature of between 90 °C to 130 °C, even more preferred from 95 to 120°C.

[0092] Further, it is possible that components (B1) and (B2) act as polymeric surfactant in the compositions according to the invention.

[0093] Suitable components (B1) are sold under the trade name Xiran® by Polyscope. Suitable components (B2) are sold under the trade name Xiran® 1440 by Polyscope.

[0094] Composition II according to the invention further comprises at least one elastomer and/ or at least one wax, preferably at least one vegetal wax as component (C).

[0095] The term “elastomer” refers to a polymeric compound having viscoelastic properties, weak intermolecular forces, a low young’s modulus and a high failure strain compared to other materials.

[0096] The term “wax” refers to organic compounds which are solid at atmospheric temperature, but have a very low melting temperature (e.g. 35°C) without decomposing. Waxes are usually derived from high fatty acid esters, having long aliphatic alkyl chains (typically C36 to C50) or from polymers (700 < Molecular weight < 10,000) and are insoluble in water, but soluble in nonpolar organic solvents.

[0097] Wax has a relatively low viscosity at temperature slightly above the melting point.

[0098] Today, there is a large variety of waxes available on the market, often classified according to their origin. Waxes can be subdivided into natural and synthetic. Natural waxes can further be divided into fossil waxes (e.g. petroleum waxes) and non-fossil waxes (e.g. animal and vegetable waxes).

[0099] Examples of natural waxes are for instance beeswax, carnauba wax, corn wax, coconut wax and soybean wax, palm hydrogenated oil, corn hydrogenated oil, coconut hydrogenated oil, castor hydrogenated oil, rapeseed hydrogenated oil or a mixture thereof.

[00100] Examples of synthetic waxes include for instance petroleum derived paraffin wax, polyethylene wax, Fischer-Tropsch (FT) wax and Montan wax. The most used wax type is the petroleum-based paraffin wax.

[00101] Wax can be employed in form of emulsions having a certain solid content, e.g. 40%.

[00102] It is possible that the amount of the at least one wax in compositions IIw and IIew according to the invention is at least 1.0 wt%, or at least or at least 2.0 wt%, or at least 5.0 wt %, or at least 6.0 wt%, or at least 7.5 wt%, or at least 10.0 wt%, or at least 11 wt%, or at least 13 wt%, or at least 14 wt%, or at least 15 wt%, or at least 42.0 wt%, or at least 40 wt%, or at least 35.0 wt%, or at least 30.0 wt%, or at least 25.0 wt%, or at least 20.0 wt%, or at most 50 wt%, or at most 45 wt%, or is in the range of from 1.0 wt%

to 50.0 wt%, or from 5.0 wt% to 50.0 wt%, or from 5.0 wt% to 45.0 wt%, or from 10wt% to 50 wt%, or from 10 wt% to 45 wt%, wherein the dry wt% of the components (A), (B1)/(B2) and (C) add up to 100 wt%.

[00103] It is possible, that composition II according to the invention contains only at least one elastomer as component (C), but no wax. This composition according to the invention will be referred to as “composition IIe” herein.

[00104] It is also possible, that composition II according to the invention contains only at least one wax as component (C), but no elastomer. This composition according to the invention will be referred to as “composition IIw” herein.

[00105] It is possible, that composition II according to the invention contains both at least one elastomer and at least one wax as component (C). This composition according to the invention will be referred to as “composition IIew” herein.

[00106] In case the description just refers to “composition II” it is referred to compositions IIe, IIw and IIew.

[00107] It is possible to choose the at least one elastomer from the non-limiting group consisting of ethylene/vinyl acetate, polybutadiene, natural latexes, synthetic latexes, styrene-butadiene emulsions or mixtures thereof. Preferred are natural latex or polybutadiene or mixtures thereof.

[00108] It further is possible that the amount of the at least one elastomer in compositions IIe and IIew according to the invention is at least 1.0 wt%, or at least 2.0 wt%, or at least 5.0 wt %, or at least 6.0 wt%, or at least 7.5 wt%, or at least 10.0 wt%, or at least 11 wt%, or at least 13 wt%, or at least 14 wt%, or at least 15 wt%, or at most 42.0 wt%, or at most 40 wt%, or at most 35.0 wt%, or at most 30.0 wt%, or at most 25.0 wt%, or at most 20.0 wt%, or is in the range of from 1.0 wt% to 42.0 wt%, or from 5.0 wt% to 42.0 wt%, or from 5.0 wt% to 40.0 wt%, or from 5.0 wt% to 35.0 wt%, or from 5.0 wt% to 30.0 wt% or from 5.0 to 25.0 wt%, or from 5.0 to 20.0 wt%, wherein the dry wt% of the components (A), (B1)/(B2) and (C) add up to 100 wt%. Preferred amounts of the at least one elastomer in the compositions IIe and IIew according to the invention are in the range of from 1.0 wt% to 42.0 wt%, or from 5.0 to 42.0 wt%, or from 5.0 to 30.0 wt%, or from

5.0 to 25.0 wt%, or from 5.0 to 20.0 wt% wherein the dry wt% of the components (A), (B1)/(B2) and (C), add up to 100 wt%.

[00109] The glass transition temperature T_g of the at least one elastomer can be at least -90°C , or at least -80°C , or at least -70°C , or up to -50°C , or up to -60°C , or range from -50°C to -90°C , or from -60°C to -80°C . The glass transition temperature T_g is determined using the same method as disclosed above, using DSC method (Differential Scanning Calorimetry), measurement starts at -85°C and until 200°C , heating is done with a ramp over 15 minutes.

[00110] It is possible that compositions IIe and IIew according to the invention contain two or more elastomers, such as one, two, three or four elastomers.

[00111] It is further possible that the at least one elastomer comprises or consists only natural latex and is present in an amount of from 1.0 wt% to 42.0 wt%, or from 1.0 wt% to 40.0 wt%, or from 1.0 to 20.0 wt%, or from 5.0 wt% to 42.0 wt%, or from 5.0 to 40.0 wt%, or from 5.0 to 30.0 wt%, or from 5.0 to 25.0 wt%, or from 5.0 to 20.0 wt% wherein the dry wt% of the components (A), (B1)/(B2) and (C) add up to 100 wt%.

[00112] It is also possible that the at least one elastomer comprises or consists of only polybutadiene and is present in an amount of from 1.0 wt% to 42.0 wt%, or from 1.0 wt% to 40.0 wt%, or from 1.0 to 20.0 wt%, or from 5.0 wt% to 42.0 wt%, or from 5.0 to 40.0 wt%, or from 5.0 to 30.0 wt%, or from 5.0 to 25.0 wt%, or from 5.0 to 20.0 wt%, wherein the dry wt% of the components (A), (B1)/(B2) and (C) add up to 100 wt%.

[00113] Further, it is possible that the at least one elastomer comprises only natural latex and polybutadiene in an amount of from 1.0 wt% to 42.0 wt%, or from 1.0 wt% to 40.0 wt%, or from 1.0 to 20.0 wt%, or from 5.0 wt% to 42.0 wt%, or from 5.0 to 40.0 wt%, or from 5.0 to 30.0 wt%, or from 5.0 to 25.0 wt%, or from 5.0 to 20.0 wt%, wherein the dry wt% of the components (A), (B1)/(B2) and (C) add up to 100 wt%.

[00114] It is further possible that the at least one elastomer comprises natural latex and polybutadiene and further elastomers known in the prior art.

[00115] It is possible that composition II according to the invention comprises or consists of component (A) in an amount in the range of from 30.0 wt% to 90.0 wt%; component (B1)/(B2) in an amount in the range of from 2.0 wt% to 40.0 wt%; and

component (C) in an amount in the range of from 1.0 wt% to 42.0 wt% in case component (C) is an elastomer, and/or 1.0 wt% to 50.0 wt% in case component (C) is a wax; wherein the wt% of the components (A), (B1)/(B2) and (C) are based on the total dry weight of the composition II add up to 100 wt%.

[00116] The compositions according to the invention can further comprise one or more additional components known in the art and used within compositions applied to substrates in order to provide any resistances. Non-limiting examples for such additional components are non-ionic surfactants, ionic surfactants, transfer agents, buffering agents, inert salts pH adjusting agents, preservatives, dyes, pigments, defoamers, thickeners, waxes, wetting agents, plasticizers, or combinations thereof.

[00117] Optionally, it is possible that the compositions according to the invention comprise one or more non-ionic surfactants such as but not limited to alcohol ethoxylates, ethylene oxide-propylene oxide block copolymers, alcohol alkoxylates, fatty acid ethoxylates, fatty amine ethoxylates or mixtures thereof.

[00118] Further optionally, it is possible that the compositions according to the invention comprise one or more ionic surfactants such as but not limited to salts of fatty acids, alkylbenzene sulfonates such as sodium dodecylbenzene sulfonate, alkylsulfonates, fatty alcohol sulfates such as sodium lauryl sulfate, alkylether sulfates such as sodium dodecyl poly(oxyethylene) sulfate or mixtures thereof.

[00119] In addition, it is possible that the optional one or more non-ionic and/or ionic surfactant is present in an amount of at least 0.01 wt%, or at least 0.05 wt%, or at least 0.1 wt%, or at least 0.25 wt%, or at most 5.0 wt%, or at most 4.0 wt%, or of from 0.01 wt% to 5.0 wt%, or from 0.05 wt% to 5.0 wt%, or from 0.1 wt% to 5.0 wt%, or from 0.1 to 4.0 wt%, or from 0.25 wt% to 5.0 wt%, wherein the wt% are based on the total dry weight of the compositions according to the invention combined (=100 wt%).

[00120] It is possible that composition I according to the invention comprises or consists of components (A) and (B2) and one or more additional components, preferably at least one non-ionic and/or ionic surfactant, others than component (B2).

[00121] It is also possible that composition I according to the invention comprises or consists of components (A) and (B2) and one or more additional components but being free of non-ionic and/or ionic surfactants, others than component (B2).

[00122] It is possible that composition II according to the invention comprises or consists of components (A), (B1) and/or (B2) and (C), and one or more additional components, preferably at least one non-ionic and/or ionic surfactant, others than component (B1)/(B2).

[00123] It is also possible that the compositions II according to the invention comprises or consists of components (A), (B1) and/or (B2) and (C), and one or more additional components but being free of non-ionic and/or ionic surfactants, others than component (B1)/(B2).

[00124] It is possible that the composition according to the invention comprise one or more pH adjusting agents such as but not limited to ammonium hydroxide, sodium hydroxide, potassium hydroxide, or mixtures thereof.

[00125] It is possible that the composition according to the invention is a dry composition as for example a powder or a granulate, or mixtures thereof.

[00126] It is possible that composition I according to the invention is a dry mixture only comprising components (A) and (B2).

[00127] It is possible that composition II according to the invention is a dry mixture only comprising components (A), (B1) and/or (B2) and (C).

[00128] It is also possible that composition I according to the invention is a dry mixture comprising or consisting of components (A) and (B2) in the amounts as defined above with regard to the definitions of the respective components, e.g. component (A) in an amount of from 30.0 wt% to 90.0 wt% and component (B2) in an amount of from 2.0 wt% to 40.0 wt% wherein the dry wt% of the components (A) and (B2) add up to 100 wt%.

[00129] It is also possible that composition II according to the invention is a dry mixture comprising or consisting of components (A), (B1) and/or (B2) and (C) in the amounts as defined above with regard to the definitions of the respective components, e.g. component (A) in an amount of from 30.0 wt% to 90.0 wt%, component (B1) and/or

(B2) in an amount of from 2.0 wt% to 40.0 wt% and component (C): if (C) is at least one elastomer in an amount of from 1.0 wt% to 42.0 wt% and/or wherein (C) is at least one wax in an amount of from 1.0 wt% to 50 wt%, wherein the dry wt% of the components (A), (B1) and/or (B2) and (C) add up to 100 wt%.

[00130] It is further possible that composition I according to the invention is a dry mixture comprising components (A) and (B2) and further one or more additional components in dry form such as but not limited to non-ionic surfactants, ionic surfactants, pH adjusting agents, preservatives, dyes, pigments, defoamers, thickeners, waxes, wetting agents, plasticizers, or combinations thereof.

[00131] It is further possible that composition II according to the invention is a dry mixture comprising components (A), (B1) and/or (B2) and (C) and further one or more additional components in dry form such as but not limited to non-ionic surfactants, ionic surfactants, pH adjusting agents, preservatives, dyes, pigments, defoamers, thickeners, waxes, wetting agents, plasticizers, or combinations thereof.

[00132] In addition, it is possible that composition I according to the invention is a dry mixture comprising or consisting of component (A) in an amount of from 30.0 wt% to 90.0 wt%, component (B2) in an amount of from 2.0 wt% to 40.0 wt%, and one or more additional components in dry form such as but not limited to non-ionic surfactants, ionic surfactants, pH adjusting agents, preservatives, dyes, pigments, defoamers, thickeners, waxes, wetting agents, plasticizers, or combinations thereof, preferably at least a non-ionic surfactant in an amount of 0.01 wt% to 5 wt%, wherein the wt% is based on the total dry weight of components (A) and (B2) of composition I according to the invention.

[00133] In addition, it is possible that the composition II according to the invention is a dry mixture comprising or consisting of component (A) in an amount of from 30.0 wt% to 90.0 wt%, component (B1) and/or (B2) in an amount of from 2.0 wt% to 40.0 wt% and component (C): if (C) is at least one elastomer in an amount of from 1.0 wt% to 42.0 wt% and/or wherein (C) is at least one wax in an amount of from 1.0 wt% to 50.0 wt% and one or more additional components in dry form such as but not limited to non-ionic surfactants, ionic surfactants, pH adjusting agents, preservatives, dyes, pigments, defoamers, thickeners, waxes, wetting agents, plasticizers, or combinations thereof, preferably at

least a non-ionic surfactant in an amount of 0.01 wt% to 5 wt%, wherein the wt% is based on the total dry weight of components (A), (B1) and/or (B2) and (C) of the composition according to the invention.

[00134] It is further possible that the compositions according to the invention are designed as liquid compositions comprising at least one solvent such as but not limited to organic solvents and/or water. The compositions according to the invention then may be designed as emulsion, suspension, solution, slurry or a mixture thereof. In case the solvent comprises or consists of water, the compositions according to the invention may be regarded as aqueous compositions. Preferably, the compositions according to the invention are aqueous compositions.

[00135] It is possible that the compositions according to the invention are liquid compositions comprising at least one solvent in an amount of 30.0 wt% to 100 wt%, or from 35.0 wt% to 80 wt%, or from 40 wt% to 60 wt%, wherein the wt% is based on the total weight of the compositions according to the invention; or the compositions according to the invention are liquid compositions and comprise at least one solvent in an amount of 50.0 wt% to 300 wt%, or from 50.0 wt% to 250 wt%, or from 50 wt% to 150 wt%, wherein the wt% is based on the total dry weight of components of the compositions according to the invention.

[00136] It is also possible that composition I according to the invention is a liquid composition comprising or consisting of components (A) and (B2) and a solvent which is an organic solvent or water, preferably water.

[00137] It is also possible that composition II according to the invention is a liquid composition comprising or consisting of components (A), (B1) and/or (B2) and (C), and a solvent which is an organic solvent or water, preferably water.

[00138] In addition, it is possible that composition I according to the invention is a liquid composition comprising or consisting of component (A) in an amount of from 15.0 wt% to 80.0 wt%; component (B2) in an amount of from 2.0 wt% to 40.0 wt% and at least one solvent as organic solvents or water, preferably water, in an amount of 30.0 wt% to 100 wt%, wherein the wt% are based on the total weight of the composition.

[00139] In addition, it is possible that composition II according to the invention is a liquid composition comprising or consisting of component (A) in an amount of from 15.0 wt% to 80.0 wt%; components (B1) and/or (B2) in an amount of from 2.0 wt% to 40.0 wt%; component (C) in an amount of from 2.5 wt% to 24.0 wt%; and at least one solvent as organic solvents or water, preferably water, in an amount of 30.0 wt% to 100 wt%, wherein the wt% are based on the total weight of the composition.

[00140] It is also possible that composition I according to the invention is a liquid composition comprising or consisting of component (A) in an amount of from 30.0 wt% to 90.0 wt% and component (B2) in an amount of from 2.0 wt% to 40.0 wt%; and at least one solvent as organic solvents or water, preferably water, in an amount of 50.0 wt% to 300 wt%, wherein the wt% are based on the total dry weight of components (A) and (B2) of composition I according to the invention.

[00141] It is also possible that composition II according to the invention is a liquid composition comprising or consisting of component (A) in an amount of from 30.0 wt% to 90.0 wt%; component (B1) and/or (B2) in an amount of from 2.0 wt% to 40.0 wt%; component (C) in an amount of from 1.0 wt% to 42 wt%; and at least one solvent as organic solvents or water, preferably water, in an amount of 50.0 wt% to 300 wt%, wherein the wt% are based on the total dry weight of components (A), (B) and (C) of composition II according to the invention.

[00142] In particular it is possible that composition I according to the invention is a liquid composition comprising or consisting of component (A) in an amount of from 30.0 wt% to 80.0 wt% and component (B2) in an amount of from 2.0 wt% to 40.0 wt%, and water in an amount of from 100.0 wt% to 200.0 wt%, wherein the wt% are based on the total dry weight of components (A) and (B2) of composition I according to the invention.

[00143] In particular it is possible that composition II according to the invention is a liquid composition comprising or consisting of component (A) in an amount of from 30.0 wt% to 80.0 wt%; component (B1) and/or (B2) in an amount of from 2.0 wt% to 40.0 wt%; component (C) in an amount of from 1.0 wt% to 50.0 wt%, and water in an amount

of from 100.0 wt% to 200.0 wt%, wherein the wt% are based on the total dry weight of components (A), (B1) and/or (B2) and (C) of composition II according to the invention.

[00144] In particular, it is possible that composition I according to the invention is a liquid composition comprising or consisting of component (A) in an amount of from 20.0 wt% to 40.0 wt%; component (B2) in an amount of from 5.0 wt% to 15.0 wt%; and at least one solvent as organic solvents or water, preferably water, in an amount of 30.0 wt% to 80 wt%, wherein the wt% are based on the total weight of composition I.

[00145] In particular, it is possible that composition II according to the invention is a liquid composition comprising or consisting of component (A) in an amount of from 20.0 wt% to 30.0 wt%; component (B1) and/or (B2)s in an amount of from 5.0 wt% to 15.0 wt%; component (C) in an amount of from 1.0 wt% to 10.0 wt%; and at least one solvent as organic solvents or water, preferably water, in an amount of 30.0 wt% to 80 wt%, wherein the wt% are based on the total weight of composition II.

[00146] Further, it is also possible that composition I according to the invention is a liquid composition comprising or consisting of components (A) and (B2), at least one solvent as organic solvents or water, preferably water, and further one or more additional components such as but not limited to non-ionic surfactants, ionic surfactants, pH adjusting agents, preservatives, dyes, pigments, defoamers, thickeners, waxes, wetting agents, plasticizers, or combinations thereof.

[00147] Further, it is also possible that composition II according to the invention is a liquid composition comprising or consisting of components (A), (B1) and/or (B2)) and (C), at least one solvent as organic solvents or water, preferably water, and further one or more additional components such as but not limited to non-ionic surfactants, ionic surfactants, pH adjusting agents, preservatives, dyes, pigments, defoamers, thickeners, waxes, wetting agents, plasticizers, or combinations thereof.

[00148] It is also possible that composition I according to the invention is a liquid composition comprising or consisting of component (A) in an amount of from 30.0 wt% to 90.0 wt%; component (B2) in an amount of from 2.0 wt% to 40.0 wt%; at least one solvent as organic solvents or water, preferably water, in an amount of 50.0 wt% to 300 wt%; and at least one or more non-ionic or ionic surfactants, others than component (B2) in an

amount of from 0.01 wt% to 5.0 wt%, wherein the wt% are based on the total dry weight of components (A) and (B2) of composition I according to the invention.

[00149] It is also possible that composition II according to the invention is a liquid composition comprising or consisting of component (A) in an amount of from 30.0 wt% to 90.0 wt%; component (B1) and/or (B2) in an amount of from 2.0 wt% to 40.0 wt%; component (C) in an amount of from 1.0 wt% to 42.0 wt%; at least one solvent as organic solvents or water, preferably water, in an amount of 50.0 wt% to 300 wt%; and at least one or more non-ionic or ionic surfactants, others than component (B1)/(B2) in an amount of from 0.01 wt% to 5.0 wt%, wherein the wt% are based on the total dry weight of components (A), (B1) and/or (B2) and (C) of composition II according to the invention.

[00150] It is further possible that composition I according to the invention is a liquid mixture comprising or consisting of component (A) in an amount of from 30.0 wt% to 90.0 wt%; and component (B2) in an amount of from 2.0 wt% to 40.0 wt%; at least one solvent as organic solvents or water, preferably water, in an amount of 50.0 wt% to 300 wt%; and at least one or more non-ionic and/or ionic surfactant, others than component (B2) in an amount of from 0.08 wt% to 5.0 wt%, wherein the wt% are based on the total dry weight of components (A) and (B2) of composition I according to the invention

[00151] It is further possible that composition II according to the invention is a liquid mixture comprising or consisting of component (A) in an amount of from 30.0 wt% to 90.0 wt%; component (B1) and/or (B2) in an amount of from 2.0 wt% to 40.0 wt%; component (C) in an amount of from 1.0 wt% to 50.0 wt%; at least one solvent as organic solvents or water, preferably water, in an amount of 50.0 wt% to 300 wt%; and at least one non-ionic and/or ionic surfactant, others than component (B1)/(B2) in an amount of from 0.08 wt% to 5.0 wt%, wherein the wt% are based on the total dry weight of components (A), (B1) and/or (B2) and (C) of compositions II according to the invention

[00152] In addition, it is possible that composition I according to the invention is a liquid mixture comprising component (A) in an amount of from 15.0 wt% to 80.0 wt%; component (B2) in an amount of from 2.0 wt% to 40.0 wt%; at least one solvent as organic solvents or water, preferably water, in an amount of 30.0 wt% to 100.0 wt%; and at least

one non-ionic and/or ionic surfactant, others than component (B2) in an amount of from 0.005 wt% to 5.0 wt%, wherein the wt% are based on the total weight of composition I.

[00153] In addition, it is possible that composition II according to the invention is a liquid mixture comprising component (A) in an amount of from 15.0 wt% to 80.0 wt%; component (B1) and/or (B2) in an amount of from 2.0 wt% to 40.0 wt%; component (C) in an amount of from 2.5 wt% to 24.0 wt%; at least one solvent as organic solvents or water, preferably water, in an amount of 30.0 wt% to 100.0 wt%; and at least one non-ionic and/or ionic surfactant, others than component (B1)/(B2) in an amount of from 0.005 wt% to 5.0 wt%, wherein the wt% are based on the total weight of compositions II.

[00154] In addition, it is possible that composition I according to the invention is a liquid mixture comprising or consisting of component (A) in an amount of from 20.0 wt% to 80.0 wt%; component (B2) in an amount of from 4.0 wt% to 40.0 wt%; at least one solvent as organic solvents or water, preferably water, in an amount of 50.0 wt% to 250.0 wt%; and at least one non-ionic and/or ionic surfactant in an amount of from 0.01 wt% to 2.5 wt%, wherein the wt% are based on the total weight of composition I.

[00155] In addition, it is possible that compositions II according to the invention is a liquid mixture comprising or consisting of component (A) in an amount of from 20.0 wt% to 80.0 wt%; component (B1) and/or (B2) in an amount of from 4.0 wt% to 40.0 wt%; component (C) in an amount of from 5.0 wt% to 24.0 wt%; at least one solvent as organic solvents or water, preferably water, in an amount of 50.0 wt% to 250.0 wt%; and at least one non-ionic and/or ionic surfactant in an amount of from 0.01 wt% to 2.5 wt%, wherein the wt% are based on the total weight of compositions II.

[00156] Further, all dry or liquid compositions according to the invention disclosed may additionally include compounds remaining from the copolymerization reaction of the comprised copolymers. The term "compounds remaining from the copolymerization reaction of the comprised copolymers" refers to any monomer, oligomers, salts, solvents, reagents, degradation product, by-products or combinations thereof being derived from the (co-)polymerization reactions performed in order to obtain components (A), (B1), (B2) or (C).

[00157] The invention further relates to a method II of manufacturing composition II according to invention comprising at least the following steps a) and b):

a) Performing sub-steps i., ii., optionally iii.:

- i. providing component (B1) and/or (B2) to the first reaction area;
- ii. providing at least the monomers (A1) and (A2) to a second reaction area to obtain a monomer mixture; optionally combining the monomer mixture in the second reaction area with the mixture of the first reaction area; and copolymerizing said monomer mixture; or provide component (A) directly;
- iii. optionally mixing the composition obtained in step i. and/or the composition obtained in step ii. to provide a first copolymer mixture;

a) Addition of component (C) to the copolymer mixture obtained in step a);

wherein optionally in any of steps a)i., a)ii., a)iii., or b) one or more additional components may be added to the respective mixtures.

[00158] The invention relates to a method I of manufacturing composition I comprising at least step a):

a) Performing sub-steps i., ii., optionally iii.:

- i) providing component (B2) to the first reaction area;
- ii) providing at least the monomers (A1) and (A2) to a second reaction area to obtain a monomer mixture; optionally combining the monomer mixture in the second reaction area with the mixture of the first reaction area; and copolymerizing said monomer mixture; or provide component (A) directly;
- iii) optionally mixing the composition obtained in step i. and/or the composition obtained in step ii. to provide a first copolymer mixture;

wherein optionally in any of steps a)i., a)ii., a)iii., one or more additional components may be added to the respective mixtures.

[00159] If not stated otherwise, when it is referred to "method", the method I for manufacturing composition I according to the invention as well as method II for manufacturing composition II according to the invention are meant. The definitions, ranges, determination methods, etc. as disclosed before and below apply here for the method for manufacturing of the composition according to the invention as well.

[00160] The term “reaction area” refers to any reaction chamber known in the prior art suitable for performing the respective reactions, such as but not limited to vessels, beakers, reactors, flasks or combinations thereof.

[00161] In step a) of the methods according to the invention, steps i., ii. and optionally iii are performed.

[00162] In step i., component(s) (B1)/(B2) of the compositions according to the invention is/are provided to a first reaction area.

[00163] Optionally, one or more additional components can be added before, during and/or after the provision of components (B1)/(B2) of the compositions according to the invention. Suitable additional components are known in the prior art and can be selected from the non-limiting group consisting of such as non-ionic surfactants, ionic surfactants, pH adjusting agents, preservatives, dyes, pigments, defoamers, thickeners, waxes, wetting agents, plasticizers, or combinations thereof.

[00164] Further, it is possible that component(s) (B1)/(B2) of the compositions according to the invention is/are added in step i. in a dry form; or as a liquid mixture such as in combination with at least one solvent, like water.

[00165] In addition, it is possible that component(s) (B1)/(B2) is/are provided in a dry form in an amount of from 80.0 wt% to 100 wt% optionally together with a non-ionic and/or ionic surfactant in an amount of from 0.0 wt% to 20.0 wt%, wherein the wt% are based on the total weight of the components provided in step i.

[00166] In addition, it is possible that component(s) (B1)/(B2) is/are provided as a liquid composition in an amount of from 2.0 wt% to 40.0 wt%, optionally together with a non-ionic and/or ionic surfactant in an amount of from 0.01 wt% to 2.5 wt% and at least one solvent, preferably comprising or consisting of water, in an amount of 70.0 wt% to 90.0 wt%, wherein the wt% are based on the total weight of the components provided in step i.

[00167] Further, it is possible to pre-temper the mixture in the first reaction area comprising component(s) (B1)/(B2) of the compositions according to the invention by any technical means known in the art to a temperature of at least 20 °C, or at least 30 °C, or at least 40 °C, or at most 120 °C, or at most 100 °C, or at most 90 °C, or from 20 °C to

120 °C, or from 30 °C to 100 °C, or from 40 °C to 90 °C, or to 80°C, or to room temperature.

[00168] In step ii., at least the monomers (A1) and (A2) are provided in at least one solvent, preferably comprising or consisting of water, to a second reaction area to obtain a monomer mixture.

[00169] Optionally, it is possible to add one or more additional components before, during and/or after the provision of at least monomers (A1) and (A2) to the second reaction area. Suitable additional components are known in the prior art and can be selected from the non-limiting group consisting of such as non-ionic surfactants, ionic surfactants, pH adjusting agents, preservatives, dyes, pigments, defoamers, thickeners, waxes, wetting agents, plasticizers, or combinations thereof.

[00170] The at least one thickener can be selected from cellulosics, hydrophobically modified alkali swellable emulsions (HASE), hydrophobically modified polyurethanes (HEUR), hydrophobically modified polyethers (HMPE), alkali swellable emulsions (ASE) as well as specialty clays, i.e. hydrated magnesium aluminosilicate, or mixtures thereof.

[00171] The at least one at least one plasticizer can be selected from phthalates and adipates of C8 to C12 alcohols, preferably di(2-ethylhexyl) adipate, diisononyl adipate, diisodecyl adipate, di(2-ethylhexyl) phthalate, diisononyl phthalate and diisodecyl phthalate, or mixtures thereof.

[00172] It is possible that monomer (A1) is provided in an amount of from 20.0 wt% to 75.0 wt% and monomer (A2) is provided in an amount of from 80.0 wt% to 25.0 wt%, wherein the wt% are based on the total weight of the monomers (A1) and (A2) provided in step ii.

[00173] It is possible that monomer (A1) is provided in an amount of from 20.0 wt% to 75.0 wt% and monomer (A2) is provided in an amount of from 80.0 wt% to 25.0 wt% together with at least one solvent, preferably comprising or consisting of water, in an amount of from 10.0 wt% to 35.0 wt%, wherein the wt% are based on the total weight of the components provided in step ii..

[00174] In addition, it also is possible that monomer (A1) is provided in an amount of from 20.0 wt% to 75.0 wt% and monomer (A2) is provided in an amount of from

80.0 wt% to 25.0 wt% together with at least one solvent, preferably comprising or consisting of water, in an amount of from 10.0 wt% to 30.0 wt% and a non-ionic and/or ionic surfactant in an amount of from 0.01 wt% to 5.0 wt%, wherein the wt% are based on the total weight of the components provided in step ii..

[00175] Further, it is possible to pre-temper the monomer mixture comprising at least monomers (A1) and (A2) of the compositions according to the invention by any technical means known in the art to a temperature of at least 0 °C, or at least 10 °C, or at least 20 °C, or at most 80 °C, or at most 60 °C, or at most 40 °C, or from 0 °C to 80 °C, or from 10 °C to 60 °C, or from 20 °C to 40 °C, or to below 25°C.

[00176] Further optionally, it is possible to add before, during and/or after the provision of monomer (A1) and (A2) to the monomer mixture one or more additional monomers (A3) in step ii.

[00177] Optionally, it is possible to combine the monomer mixture of the second reaction area, with the mixture obtained in step i.

[00178] Further in step ii., the monomer mixture is copolymerized in presence or absence of the mixture obtained in step i. to obtain component (A). Preferably, the mixture of step i. is present during the copolymerization of the monomer mixture of step ii.

[00179] It is possible to perform the copolymerization in step ii. at a temperature in the range of from 0 °C to 95 °C, or from 10 °C to 90 °C, or from 20 °C to 90 °C, or from 40 °C to 80 °C for a time in the range of from 0.25 h to 24 h, or from 0.5 h to 18 h, or from 1 h to 12 h, or from 1 h to 8 h.

[00180] It is possible that the copolymerization requires an initiator to start the reaction. Initiators suitable for the reaction are not limited and may be found in the prior art as for example but not limited to heat, irradiation, or initiator compounds able to be used as chain reaction starter.

[00181] The term "chain reaction starter" refers to any compound known in the prior art which can be used to initiate a polymeric chain reaction by any mechanism known as for example but not limited to forming a radical, a charged atom etc. Non-limiting examples are sodium persulfate, azobisisobutyronitrile (AIBN), ammonium persulfate,

potassium persulfate, hydrogen peroxide, tert-butyl hydroperoxide, or combinations thereof.

[00182] It is possible to prepare an initiator compound mixture in a third reaction area comprising at least one solvent and at least one initiator, preferably comprising or consisting of water and add said initiator compound mixture after complete homogenization to the mixture in the second reaction area.

[00183] It is possible to prepare an initiator compound mixture in a third reaction area comprising at least one solvent, preferably comprising or consisting of water in an amount of from 80.0 wt% to 99.5 wt% and at least one initiator, preferably sodium persulfate, in an amount of 0.5 wt% to 20.0 wt%, wherein the wt% are based on the total weight of the components provided in the third reaction area.

[00184] Further, it is possible to pre-temper the initiator compound mixture to a temperature of at least 0 °C, or at least 10 °C, or at least 20 °C, or at most 80 °C, or at most 60 °C, or at most 40 °C, or of from 0 °C to 80 °C, or of from 10 °C to 60 °C, or of from 20 °C to 40 °C, or to below 25°C.

[00185] It is possible to add the initiator compound mixture to the mixture in the second reaction area all at once, or portionwise over the duration of the copolymerization. The initiator compound mixture can be added simultaneously with the monomer mixture of the second reaction area to the mixture of the first reaction area, portionwise or all at once.

[00186] Further, it is possible that the mixture resulting from the combination of the initiator compound mixture and the mixture in the second reaction area is allowed to stand for an additional timeframe in the range of from 0.25 h to 24 h, or from 0.5 h to 18 h, or from 1 h to 12 h, or from 1 h to 8 h at a temperature of from 0°C to 95°C, or from 10°C to 90°C, or from 20°C to 90°C, or from 40 °C to 80°C.

[00187] Optionally, before the copolymerization of step ii., a homogenization step can be performed in order to homogenize all reagents present in the mixture in the second reaction area.

[00188] Preferably, the copolymerization is designed as emulsion polymerization. Preferably, component(s) (B1)/(B2) act(s) as polymeric surfactant in the

copolymerization, which is preferably designed as emulsion polymerization. Preferably, no non-ionic and/or ionic surfactants are present in the copolymerization.

[00189] Further, it is possible to completely dry the copolymer mixture obtained after the finalization of copolymerization in step ii. of the methods according to the invention by any technical means known in the prior art.

[00190] Instead of the provision of at least monomers (A1) and (A2) and the subsequent copolymerization reaction, it is possible to directly provide readily synthesized component (A) in step ii. of the methods according to the invention.

[00191] In step iii. Optionally a mixing step is performed after performing sub-steps i. and ii. of method II according to the invention, in which the mixture of component (B1) and/or (B2) in the first reaction area and the mixture of component (A) in the second reaction area are combined and optionally homogenized.

[00192] The mixture obtained in step iii. can be a dry or a liquid mixture.

[00193] In step b) of method II according to the invention, component (C) is added to the copolymer mixture obtained from step a) of method II according to the invention.

[00194] Optionally, it is possible to add before, during and/or after the provision of component (C) to the copolymer mixture one or more additional components such as non-ionic surfactants, ionic surfactants, pH adjusting agents, preservatives, dyes, pigments, defoamers, thickeners, waxes, wetting agents, plasticizers, or combinations thereof.

[00195] It is also possible to add component (C) of composition II according to the invention in a dry form or in a liquid mixture for example together with at least one solvent, preferably comprising or consisting of water.

[00196] It is further possible that component (C) of composition II according to the invention is added as an aqueous emulsion, an aqueous suspension, an aqueous solution, an aqueous slurry or a mixture thereof.

[00197] Further, it is possible to provide component (C) of composition II according to the invention in dry form.

[00198] It is possible to prepare in the first reaction area a liquid mixture comprising component (B1)/(B2) in an amount of from 10.0 wt% to 40.0 wt% together with a surfactant in an amount of from 0.01 wt% to 2.5 wt% and at least one solvent, preferably

comprising or consisting of water, in an amount of 70.0 wt% to 90.0 wt%, wherein the wt% are based on the total weight of the components provided in the first reaction area; and in the second reaction area a mixture comprising monomer (A1) in an amount of from 20.0 wt% to 75.0 wt% and monomer (A2) in an amount of from 80.0 wt% to 25.0 wt% together with at least one solvent, preferably comprising or consisting of water, in an amount of from 10.0 wt% to 30.0 wt% and a surfactant in an amount of from 0.01 wt% to 5.0 wt%, wherein the wt% are based on the total weight of the components provided in the second reaction area;

in case of method II according to the invention in a third reaction area a mixture comprising at least one solvent, preferably comprising or consisting of water in an amount of from 80.0 wt% to 99.5 wt% and at least one initiator preferably sodium persulfate in an amount of 0.5 wt% to 20.0 wt%, wherein the wt% are based on the total weight of the components provided in the third reaction area; and

to pre-temper the mixture of the first reaction area to a temperature in the range of from 40 °C to 90 °C and add it to the mixture in the second reaction area and then add the mixture of the third reaction area in portions over a period of from 1 h to 8 h at a temperature in the range of from 40 °C to 90 °C; and in case of method II according to the invention to provide component (C) as an aqueous dispersion to obtain a liquid composition according to the invention.

[00199] In addition, it is possible to prepare in the first reaction area reaction area a dry mixture comprising component(s) (B1)/(B2) in an amount of from 80.0 wt% to 99.99 wt% together with a surfactant in an amount of from 0.01 wt% to 20.0 wt%, wherein the wt% are based on the total weight of the components provided in the first reaction area; and in the second reaction area a mixture comprising monomer (A1) in an amount of from 20.0 wt% to 75.0 wt% and monomer (A2) in an amount of from 80.0 wt% to 25.0 wt% together with at least one solvent, preferably comprising or consisting of water, in an amount of from 10.0 wt% to 30.0 wt% and a surfactant in an amount of from 0.01 wt% to 5.0 wt%, wherein the wt% are based on the total weight of the components provided in the second reaction area;

in a third reaction area a mixture comprising at least one solvent, preferably comprising or consisting of water in an amount of from 80.0 wt% to 99.5 wt% and at least one initiator preferably sodium persulfate in an amount of 0.5 wt% to 20.0 wt%, wherein the wt% are based on the total weight of the components provided in the third reaction area; and to pre-temper the mixture of the first reaction area to a temperature in the range of from 40 °C to 90 °C and add it to the mixture in the second reaction area and then add the mixture of the third reaction area in portions over a period of from 1 h to 8 h at a temperature in the range of from 40 °C to 90 °C; and to dry it completely after the reaction; and in case of method II according to the invention to provide component (C) in dry form in an amount of from 1 to 50 wt% to obtain dry compositions according to the invention, wherein the wt% are based the total dry wt% of the components (A), (B1)/(B2) / (C) add up to 100 wt%.

[00200] Further, it is possible to prepare in the first reaction area a dry mixture comprising component(s) (B1)/(B2) in an amount of from 80.0 wt% to 99.99 wt% together with a surfactant in an amount of from 0.01 wt% to 20.0 wt%, wherein the wt% are based on the total weight of the components provided in the first reaction area; and in the second reaction area component (A); and combine the mixtures comprised in the first reaction area and in the second reaction area and mix them together; and in case of method II according to the invention to add component (C) in dry form, to obtain dry compositions according to the invention as defined above.

[00201] The invention further relates to the use of the compositions according to the invention or as manufactured by the methods according to the invention as barrier on a substrate, wherein the substrate is as defined above. The definitions, ranges, determination methods, etc. as disclosed before and below, apply here for the use of the composition according to the invention as well.

[00202] In particular, the invention further relates to the use of composition I according to the invention or as manufactured by method I according to the invention as liquid-barrier or heat seal on a substrate, wherein the substrate is as defined above, in

particular wherein the substrate is a food or beverage container, such as: hot and cold beverages, soup containers, ice cream cups and other food packages.

[00203] The term “heat seal” or “heat-sealing” as used within the context of the present application means that when a hot sealant, i.e. composition I according to the invention, is coated to surfaces of a substrate melted and hot pressed, the two surfaces come into contact. Thus, heat sealing is a method where two materials are attached to each other by heat and pressure for a certain time. This step is known as the wetting phase which occurs over the sealing area. In a short period of time, a bond between the two surfaces is rapidly formed through the melting of the coating layer. After this step, there is a solidification of the coating layer holding the surfaces together and thus enhancing the seal strength. The sealability of a coating lies in its ability to act as its own bond-forming agent without any extra hot melt adhesive. A good seal will give full paper fibre tear and it is crucial to guarantee food safety and quality.

[00204] The invention further relates to the use of composition IIe according to the invention or as manufactured by method II according to the invention as barrier, in particular as oil-barrier and/or grease-barrier and/or liquid-barrier and/or heat seal on a substrate, wherein the substrate is as defined above.

[00205] The invention further relates to the use of the composition IIw according to the invention or as manufactured by the method II according to the invention as barrier, in particular as liquid-barrier and/or heat seal on a substrate, wherein the substrate is as defined above.

[00206] Typical applications of composition II according to the invention include ream wrap paper, paper trays and food packaging. When applied to the paper and paperboard, the coated product constitutes a product that can be used as a food contact surface.

[00207] The invention further relates to the use of the composition IIew according to the invention or as manufactured by the methods according to the invention as barrier, in particular as oil-barrier and/or grease-barrier and/or liquid-barrier and heat seal on a substrate, wherein the substrate is as defined above.

[00208] The invention further relates to a method of manufacturing a coated substrate comprising the following steps:

I) applying composition according to the invention or a composition as manufactured according to the invention onto the substrate;

II) drying the composition according to the invention or a composition as manufactured according to the invention on the substrate.

[00209] The definitions, ranges, determination methods, etc. as disclosed before and below, apply here as well.

[00210] The term “applying” thereby includes any technical means known in the art to apply a composition, in particular a liquid composition onto a substrate such as but not limited to coating, spraying, brushing, dipping, or combinations thereof.

[00211] In step I) of the method of manufacturing a coated substrate according to the invention, a composition according to the invention or a composition as manufactured according to the invention is applied onto a suitable substrate.

[00212] The composition according to the invention or the composition as manufactured by the method according to the invention can be directly used in step I. In case it is a liquid composition. In case the composition according to the invention or the composition as manufactured by the method according to the invention is a dry composition, addition of at least one solvent, preferably comprising or consisting of water is necessary.

[00213] It is possible to perform the applying step I. one or more times.

[00214] Further, it is possible to temper the composition and/or the substrate before, during or after step I.

[00215] In step II., the treated substrate is dried by any technical means known in the prior art such as but not limited to hot air drying, IR irradiation, drying by contact with hot metal cylinder, or combinations thereof.

[00216] Further, the invention relates to a coated substrate manufactured according to the invention comprising or consisting of the compositions according to the invention or comprising or consisting of a composition as manufactured according to the methods

according to the invention. The definitions, ranges, determination methods, etc. as disclosed before and below, apply here as well.

[00217] The invention further relates to a coated substrate comprising an overcoat selected from any overcoating known in the prior art. Non-limiting examples for overcoatings are humidity barriers, oxygen barriers, heat-sealings, gas barriers, esthetic overcoatings such as printing, varnish or to provide gloss, or combinations thereof. The definitions, ranges, determination methods, etc. as disclosed before and below, apply here as well.

[00218] Further, the invention relates to a manufacturing method of an article comprising or consisting of the coated substrate according to the invention or as manufactured according to the method according to the invention, wherein the coated substrate is subjected to measures selected from the group comprising cut, fold, gluing, curing, dyeing, or combinations thereof. The definitions, ranges, determination methods, etc. as disclosed before and below, apply here as well.

[00219] Further, the invention relates to an article comprising or consisting of the coated substrates according to the invention or as manufactured according to the methods according to the invention, wherein the article is a food container, plate, straw, bags, bowls, cloths, bags (made from paper or textile). The definitions, ranges, determination methods, etc. as disclosed before and below, apply here as well.

[00220] It is possible that the article comprising the coated substrates according to the invention or as manufactured according to the methods according to the invention is a textile, such as but not limited to clothing articles or bags.

EXAMPLES

[00221] In the following, the invention will be described in more detail, however, without being limited to the following specific embodiments.

Test procedures

Determination of liquid barrier properties according to TAPPI T441 Test Method (Cobb Test)

[00222] The liquid barrier properties are determined according to TAPPI T441 Standard Test Method (Cobb Test). The amount of liquid that can be absorbed by a given area of the sample after a specified time is measured.

[00223] The test sample paper is cut into pieces of 12.5 x 12.5 mm. This sample is pre-weighed on a balance and then placed inside the Cobb equipment when it is dry. Once the test sample paper is in place, a fixed amount of liquid (e.g. water, cola, oil or hot coffee) (100 ml ($\pm$ 5 ml)) is poured into the cylindrical container. Simultaneously a timer is started. If not stated otherwise, after 60 sec, the remaining liquid is emptied. The test sample paper (wetted side up) is placed between two blotting papers resting on a flat rigid surface and the surplus liquid is removed by moving a hand roller once back and forth over the pad without exerting any additional pressure on the roller. Samples that show signs of leakage around the clamping area should be rejected. If any liquid has passed through the sheet to the rubber mat, the test is not acceptable. When this occurs, the time is shortened to 30s. The (wet) test sample is then weighed.

[00224] The Cobb value is calculated by the following equation:

$$\text{Cobb [g/m}^2\text{]} = (W_{\text{wet}} - W_{\text{dry}}) \times 100$$

[00225] A high Cobb value indicates the ability of the substrate to easily absorb and retain moisture. A low Cobb value indicates the ability of the substrate to resist penetration and retention of moisture. Typical target Cobb values for the packaging industry are:

- Water absorbency (around room temperature): ≤ 20 g of absorbed water per m^2 ,
- Cola absorbency (around room temperature): ≤ 20 g of absorbed water per m^2 ,
- Hot coffee absorbency (around 80°C): ≤ 20 g of absorbed water per m^2 ,
- Oil absorbency (around room temperature): ≤ 20 g of absorbed oil per m^2 .

Determination of oil/grease barrier properties (according to Tappi T559 Standard Test Method)

[00226] The oil/grease resistance can also be determined according to Tappi standard T559 KIT Test. A value of 1 means bad/no oil/grease resistant properties, while a value of 12 means best/high oil grease resistant properties.

Determination of blocking temperature

[00227] The blocking temperature is determined as follows: Two test specimen (25 mm * 297 mm) of the treated substrate are prepared and placed in a superimposed relationship to each other with the treated surface directed to each other in a HT-IXS Hot Tack Tester. Standard test is carried out with a 10 s dwell time and 1 bar pressure. Both jaws are heated, with the temperature variable. "Blocking temperature" is the highest temperature for which the apparatus measures no tack, i.e. no strength to the 2 strips.

Determination of Heat Sealing Properties

[00228] The heat sealing properties are determined as follows: Two test specimen (25 mm * 297 mm) of the treated substrate are prepared and placed in a superimposed relationship to each other with the treated surface directed to each other in a HT-IXS Hot Tack Tester. Standard test is carried out with a 10 s dwell time and 2 bar pressure. Both jaws are heated, with the temperature variable. "Heat-seal temperature" correspond to the temperature which the apparatus measures a sufficient strength to seal both papers.

[00229] For the below reported tests a cardboard paper with a grammage of 250 g/m², a coating of 8-9 g/m² and a sealing area of 1,2 cm x 3,5 cm was used. Pull speed was set to 50 mm/sec. The heat sealing strength is reported in Newton and is the strength required to separate the test strips from each other, once they have sealed. The heat sealing strength is regarded as sufficient in case a value of ≥ 3 N is achieved.

Product stability tests

[00230] 100 g of the respective sample were stored in a glass flask (125 mL) at 50 °C. Samples were checked every 24 h for visible phase separation. In a second stability test, the 100 g of the respective samples were filtered on a 150 µm nylon filter. The weight of the grits remaining on the filter was weighed and expressed in ppm in

relation to the total weight of the respective product. The results may be found in the below table 5

Preparation and determination of properties of Composition I according to the invention

General preparation procedure

[00231] 300 g of demineralized water are introduced in a reactor (reactor 1). Optionally, component (B2) is added and dissolved into the demineralized water with ammonium hydroxide. This mixture is then heated to 80°C. In case of Comp. Ex. 1, 2 g of lauryl sulfate are added instead of component (B2). In case of Inv. Ex. 1 to 3 and 9 1 g lauryl sulfate are added together with component (B2).

[00232] In another reactor (reactor 2), lauryl sulfate (omitted in Inv. Ex. 5 and 7) is dissolved in demineralized water and then monomers (A1) and (A2) are added. This monomer mixture is stirred to be homogenized, and kept below 25°C.

[00233] In a third reactor (reactor 3), 1 g sodium persulfate is dissolved in 39 g of demineralized water. This solution is also kept at a temperature below 25°C.

[00234] When the internal temperature of reactor 1 reaches 80°C, the mixture contained in reactor 2 is dosed into the mixture of reactor 1, while simultaneously, also the content of reactor 3 is dosed into reactor 2. Dosage takes place within 5 hours. At the end of the dosages, pumps are rinsed with 8 g of demineralized water. The internal temperature is maintained at 80 °C for 1 hour. The thus obtained copolymer dispersion is then cooled down to room temperature.

[00235] Table 1 lists the used compounds as well as their amounts.

[00236] The results of liquid resistance tests as well as heat-sealing properties, blocking temperature and stability can be found in Tables 2 and 3.

Table 1: Compositions of comparative and inventive examples for composition I

	Component A*	Component B2*,#
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	A1	A2		
Co. Ex. 1	230 g styrene	240 g 2-ethylhexylacrylate	48%	-
Inv. Ex. 1	237 g styrene	163 g 2-ethylhexylacrylate	40%	200 g (20%)
Inv. Ex. 2	249 g styrene	172 g 2-ethylhexylacrylate	42%	100 g (10%)
Inv. Ex. 3	125 g styrene and 124 g methyl methacrylate	172 g 2-ethylhexylacrylate	42%	100 g (10%)
Inv. Ex. 4	249 g methyl methacrylate	172 g 2-ethylhexylacrylate	42%	100 g (10%)
Inv. Ex. 5	249 g methyl methacrylate	183 g 2-ethylhexylacrylate	43%	100 g (10%)
Inv. Ex. 6	249 g acrylonitrile	172 g 2-ethylhexylacrylate	42%	100 g (10%)
Inv. Ex. 7	249 g acrylonitrile	183 g 2-ethylhexylacrylate	43%	100 g (10%)
Inv. Ex. 8	241 g styrene	180 g butylacrylate	42%	100 g (10%)
Inv. Ex. 9	260 g styrene	172 g butyl acrylate and 90 g 2-ethylhexylacrylate	52%	100 g (10%)

	Water / lauryl sulfate (added to reactor 2)
Co. Ex. 1	170 g / 10 g
Inv. Ex. 1^x	125 g / 5 g
Inv. Ex. 2	125 g / 5 g
Inv. Ex. 3	125 g / 5 g
Inv. Ex. 4	121 g / 10 g
Inv. Ex. 5	-
Inv. Ex. 6	121 g / 10 g
Inv. Ex. 7	-
Inv. Ex. 8	125 g / 5 g
Inv. Ex. 9	125 g / 5 g

* % means wt% based on the total weight of the aqueous composition

Component (B2): 25.0 to 35.0 wt% maleic anhydride and 65.0 to 75.0 wt% of styrene, wherein the wt% are based on the total weight of component (B2) (=100 wt%), esterified using ethanol, butanol, isobutanol or a mixture thereof, molecular weight in the range of 1,000 g/mol to 10,000 g/mol, a glass transition temperature of between 90 °C to 130 °C; wt% of SMA and alcohol in esterification the wt% is 80wt% to 90 wt%, respectively 10 to 20 wt%, wherein the wt% are based on the total amount of SMA and alcohol (=100wt%) used in the esterification reaction

Coating procedure

[00237] All comparative compositions and inventive examples of composition I are applied using an Automatic Coater at 250 mm/s on white cardboard with a coat weight of

5g/m² and dried at a temperature of 110°C using an IR lamp. The results achieved from the herein described tests, i.e. liquid-resistance, heat-sealing force and blocking temperature may be found for the comparative examples in Table 2. The results of the stability test can be found in Table 3.

Results

Table 2: Results of liquid resistance tests as well as heat-sealing properties, blocking temperature

	Water resistance [g/m ²]	Cola resistance [g/m ²]	Hot Coffee resistance [g/m ²]	Heat-sealing force [N]	Blocking T [°C]
Co. Ex. 1	16	69	57	2.9	< 40
Inv. Ex. 1	10	15	15	3.0	80
Inv. Ex. 2	10	15	15	3.1	80
Inv. Ex. 3	10	14	14	3.0	80
Inv. Ex. 4	19	20	20	3.0	90
Inv. Ex. 5	11	20	20	3.0	90
Inv. Ex. 6	18	10	10	3.5	80
Inv. Ex. 7	12	10	10	3.5	80
Inv. Ex. 8	20	18	15	3.0	90
Inv. Ex. 9	13	18	15	3.0	90

Table 3: Results of the stability tests performed

	Result of the stability test
Inv. Ex. 1	Stable, no phase separation, no grits during filtration test after 5 months
Inv. Ex. 2	Stable, no phase separation, no grits during filtration test after 5 months
Inv. Ex. 3	Stable, no phase separation, no grits during filtration test after 5 months

Inv. Ex. 4	Stable, no phase separation, no grits during filtration test after 5 months
Inv. Ex. 5	Stable, no phase separation, no grits during filtration test after 5 months
Inv. Ex. 6	Stable, no phase separation, no grits during filtration test after 5 months
Inv. Ex. 7	Stable, no phase separation, no grits during filtration test after 5 months
Inv. Ex. 8	Stable, no phase separation, no grits during filtration test after 5 months
Inv. Ex. 9	Stable, no phase separation, no grits during filtration test after 5 months

Preparation and determination of properties of Composition IIe according to the invention

General preparation procedure:

[00238] 300 g of demineralized water are introduced in a reactor (reactor 1). Optionally component (B1) is added and dissolved into the demineralized water with ammonium hydroxide. This mixture is then heated to 80°C. In case of Comp. Ex. 1, 3 and 4, 2 g of lauryl sulfate are added instead of SMA. In case of Inv. Ex. 1, 1 g lauryl sulfate are added together with SMA.

[00239] In another reactor (reactor 2) 10 g of lauryl sulfate (omitted in Inv. Ex. 6) are dissolved into demineralized water and then, at least the monomers (A1) and (A2) are added. This monomer mixture is stirred to be homogenized, and kept below 25°C.

[00240] In a third reactor (reactor 3), 1 g sodium persulfate is dissolved in 39 g demineralized water. This solution is also kept at a temperature of below 25°C.

[00241] When the internal temperature of reactor 1, reaches 80°C, the mixture contained in reactor 2 is dosed into the mixture of reactor 1, while simultaneously, also the content of reactor 3 is dosed into reactor 2. Dosage takes place within 5 hours. At the end of the dosages, pumps are rinsed with 8 g of demineralized water. The internal temperature is maintained at 80 °C for 1 hour. The thus obtained copolymer dispersion is then cooled down to room temperature.

[00242] At room temperature, the copolymer dispersion is then formulated with addition of component I. Table 4 lists all used compounds as well as their amounts.

[00243] The results of the liquid-, grease and oil-resistance tests as well as for the blocking temperatures can be found in Table 5 in case of the comparative examples and Table 6 in case of the inventive examples of compound IIe.

Table 4a: Compositions of the comparative and the inventive examples of compound IIe.

	Component A*			Component B1*,a
	A1	A2		
Co. Ex. 1°	230 g styrene	240 g 2-ethylhexylacrylate	47%	-
Co. Ex. 2	-	-	-	-
Co. Ex. 3°	230 g styrene	240 g 2-ethylhexylacrylate	44%	-
Co. Ex. 4°	230 g styrene	240 g 2-ethylhexylacrylate	47%	-
Co. Ex. 5	230 g styrene	240 g 2-ethylhexylacrylate	47%	100 g SMA (10%)
Co. Ex. 6	230 g styrene	240 g butylacrylate	47%	100 g SMA (10%)
Co. Ex. 7	470 g butyl methacrylate		47%	100 g SMA (10%)
Co. Ex. 8	470 g butyl methacrylate		42%	100 g SMA (9%)
Co. Ex. 9	230 g styrene	240 g 2-ethylhexylacrylate	27%	100 g SMA (6%)
Inv. Ex. 1 ^x	172 g styrene	171 g 2-ethylhexylacrylate	33%	50 g SMA (5%)
Inv. Ex. 2	230 g styrene	240 g 2-ethylhexylacrylate	42%	100 g SMA (9%)
Inv. Ex. 3	230 g styrene	240 g butylacrylate	42%	100 g SMA (9%)
Inv. Ex. 4	109 g styrene	109 g 2-ethylhexylacrylate	22%	100 g SMA (10%)
Inv. Ex. 5	196 g styrene	197 g 2-ethylhexylacrylate	28%	100 g SMA (7%)
Inv. Ex. 6 [#]	230 g styrene	240 g 2-ethylhexylacrylate	42%	100 g SMA (9%)
Inv. Ex. 7	109 g methacrylate	109 g 2-ethylhexylacrylate	22%	100 g SMA (10%)
Inv. Ex. 8	109 g acrylonitrile	109 g 2-ethylhexylacrylate	46%	100 g SMA (26%)

Table 4b: Continuation of table 4a.

	Component C*	Water (added to reactor 2)
Co. Ex. 1	-	170 g
Co. Ex. 2	natural latex	
Co. Ex. 3	178 g natural latex (10%)	71 g
Co. Ex. 4	100g paraffin wax (6%)	80 g

Co. Ex. 5	-	72 g
Co. Ex. 6	-	72 g
Co. Ex. 7	-	72 g
Co. Ex. 8	112 g natural latex (6%)	72 g
Co. Ex. 9	714 g natural latex (25%)	72 g
Inv. Ex. 1[*]	174 g natural latex (10%)	126 g
Inv. Ex. 2	112 g natural latex (6%)	72 g
Inv. Ex. 3	112 g natural latex (6%)	72 g
Inv. Ex. 4	252 g natural latex (15%)	72 g
Inv. Ex. 5	461 g natural latex (20%)	72 g
Inv. Ex. 6[#]	112 g natural latex (6%)	72 g
Inv. Ex. 7	151g natural latex (15%)	72 g
Inv. Ex. 8	151 g natural latex (32 %)	72 g

* % means wt% based on the total weight of the aqueous composition

[°] Comp. Examples 1, 3 and 4 are made with 2 g of lauryl sulfate, but no SMA.

^xInv. Example 1 is made with 1 g lauryl sulfate added to reactor 1 together with SMA.

[#]Inventive Example 6 is made without addition of any non-ionic or ionic surfactant.

^a Component (B1): 25.0 to 35.0 wt% maleic anhydride and 65.0 to 75.0 wt% of styrene, wherein the wt% are based on the total weight of component (B1) (=100 wt%); molecular weight in the range of 1,000 g/mol to 10,000 g/mol, a glass transition temperature of between 110°C to 150°C

Coating procedure

[00244] All comparative compositions and inventive examples of composition IIe are applied using an Automatic Coater at 250 mm/s on office white paper with a coatweight of 5 g/m² and dried at a temperature of 110°C using an IR lamp, if not reported otherwise. The results achieved from the herein described tests, i.e. liquid-resistance, oil-resistance and blocking temperature may be found for the comparative examples in Table 5 and for the inventive examples in Table 6.

General procedure for folding

[00245] All the resistances discussed in the following were measured before and after a subsequent folding process to obtain data on the foldability of the substrates treated with the compositions described in Table 4. Folding was performed on a large blotter with a 10 kg roller. The substrates were folded in half twice, once in the machine direction and once crosswise to the machine direction. Fig. 1 shows the blotter and roller as well as a result of the folding.

Table 5: Results of the water- and oil-resistance tests and determined blocking temperature of the comparative examples.

Results	Water resistance (Cobb test)		Oil resistance (KIT test)		Blocking temperature	
	b/a* [g/m ²]	comment	b/a*	comment	before*	comment
Co. Ex. 1	12/13	medium resistance	12/12	good resistance	<40 °C	too sticky at 40 °C
Co. Ex. 2	11/13	loss of resistance after folding	4/3	low resistance and loss after folding	20 °C	too sticky at room temperature
Co. Ex. 3	12/13	slight loss of resistance after folding	10/5	loss of resistance after folding	35 °C	too sticky at 40 °C
Co. Ex. 4	40/49	limited resistance and loss after folding	12/6	loss of resistance after folding	75 °C	-
Co. Ex. 5	8/8	good resistance	10/6	loss of resistance after folding	75 °C	Stickiness starts > 60°C
Co. Ex. 6	6/6	good resistance	12/6	loss of resistance after folding	50 °C	no blocking problem <50°C
Co. Ex. 7	100/100	no resistance	12/3	loss of resistance after folding	40 °C	Blocking at 40°C
Co. Ex. 8	70/70	only slight resistance	12/12	good resistance	40 °C	Blocking at 40°C
Co. Ex. 9	5/6	good resistance	12/6	loss of resistance after folding	60 °C	-

* respective result was determined before/after folding of the coated paper (g/m²)

[00246] In conclusion, low SMA proportions as in comparative examples 1 to 3 lead to undesirably sticky compositions, i.e. compositions blocking at low temperatures already, in combination with the styrene-acrylate copolymer. However, addition of SMA alone does not lead to satisfying compositions either since all resistances decrease after folding of the treated substrate and thus, are insufficient for finally shaped articles. Similar

can be observed for compositions based on acrylic copolymers as known in the prior art having deficiencies in the resistances after folding.

[00247] Further it is apparent from comparative examples 2, 3, 8 and 9 that the addition of an elastomer as e.g. natural latex may lead to an higher resistance to folding. However, the elastomer itself does not provide sufficient resistances.

Table 6: Results of the water- and oil-resistance tests and determined blocking temperature of the inventive examples.

Results	Water resistance (Cobb test)		Oil resistance (KIT test)		Blocking temperature	
	b/a*	comment	b/a*	comment	before*	comment
Inv. Ex. 1	5/5	good resistance	10/8	good resistance, slight loss after folding	60 °C	no blocking problem <60°C
Inv. Ex. 2	4/4	good resistance	12/12	good resistance	60 °C	no blocking problem <60°C
Inv. Ex. 3	5/5	good resistance	12/12	good resistance	60 °C	no blocking problem <60°C
Inv. Ex. 4	6/8	slight loss of resistance after folding	12/7	Slight loss of resistance after folding	75°C	no blocking problem <75°C
Inv. Ex. 5	5/5	good resistance	12/12	good resistance	60 °C	no blocking problem <60°C
Inv. Ex. 6	2/2	good resistance	12/12	good resistance	60 °C	no blocking problem <60°C
Inv. Ex. 7	10/13	Acceptable resistance	12/12	Good resistance	75°C	no blocking problem <75°C
Inv. Ex. 8	10/12	Acceptable resistance	12/12	Good resistance	75 °C	no blocking problem <75°C

* respective result determined either before(b)/after(a) folding of the coated paper (g/m²)

[00248] In comparison to the before discussed comparative examples, all inventive examples of composition IIe show low water uptakes in the Cobb test and high oil/grease resistance ratings in the KIT test. Further, blocking temperatures are sufficiently high to

satisfy industrial requirements. Additionally, the inventive examples of composition IIe show an improved resistance in said tests even after subsequent folding processes.

[00249] In summary, all inventive examples of composition IIe according to the invention provide good water- and oil/grease-resistances and further sufficiently high blocking temperatures and thus, solve the object of the present invention.

Table 7: Results of the stability tests performed with all samples.

	Result of the stability test
Co. Ex. 1	Product still homogeneous after 2 months; no phase separation; no grits in filtration test.
Co. Ex. 2	Dispersion stable 6 weeks.
Co. Ex. 3	Formulation stable 7 weeks; no phase separation; no grits in filtration test.
Co. Ex. 4	Formulation unstable after 4 days.
Co. Ex. 5	Product still homogeneous after 2 months; no phase separation; no grits in filtration test.
Co. Ex. 6	Product still homogeneous after 2 months; no phase separation; no grits in filtration test.
Co. Ex. 7	Product still homogeneous after 2 months; no phase separation; no grits in filtration test.
Co. Ex. 8	Product still homogeneous after 2 months; no phase separation; no grits in filtration test.
Co. Ex. 9	Formulation unstable after 3 days; > 500 ppm grits content.
Inv. Ex. 1	Product still homogeneous after 2 months; no phase separation; no grits in filtration test.
Inv. Ex. 2	Product still homogeneous after 2 months; no phase separation; no grits in filtration test.
Inv. Ex. 3	Product still homogeneous after 2 months; no phase separation; no grits in filtration test.
Inv. Ex. 4	Product still homogeneous after 56 days; no phase separation; no grits in filtration test.
Inv. Ex. 5	Product still homogeneous after 53 days; no phase separation; no grits in filtration test.
Inv. Ex. 6	Product homogeneous even after two months; no phase separation; no grits in filtration test.
Inv. Ex. 7	Product still homogeneous after 5 months; no phase separation; no grits in filtration test.
Inv. Ex. 8	Product still homogeneous after 5 months; no phase separation; no grits in filtration test.

[00250] From the product stability test results depicted in Table 7, it can be clearly seen that components as waxes or high proportions of natural latex lead to stability

issues. However, all inventive examples show satisfying storage properties at 50 °C and are thus, suitable products for coating applications.

Preparation and determination of properties of Composition IIw according to the invention

General preparation procedure

[00251] 340 liters of demineralized water are introduced in a reactor (reactor 1). 80 to 110 kg of component (B1) (same as used in preparing composition IIe) in powder form is added. The temperature is increased to 40°C and 30 kg of ammonium hydroxide (aq.) are added. This mixture is then heated to 80°C. Demineralized water is added to adjust the concentration to 20%. 480 kg of the thus prepared mixture are used in the following.

[00252] In another reactor (reactor 2) the monomers (monomer A1: 35 to 60 wt% of styrene, methyl methacrylate, and/or acrylonitrile; monomer A2: 40 to 65 wt% of 2 ethyl hexyl acrylate; wt% are based on total amount of monomers (=100 wt%)) are added (total amount 200 to 250 kg). This monomer mixture is stirred to be homogenized, and kept below 25°C.

[00253] In a third reactor (reactor 3), 2.2 kg ammonium persulfate is dissolved in 9 kg demineralized water. This solution is also kept at a temperature of below 25°C.

[00254] When the internal temperature of reactor 1, reaches 80°C, the mixture contained in reactor 2 is dosed into the mixture of reactor 1, while simultaneously, also the content of reactor 3 is dosed into reactor 2. Dosage takes place within 5 hours. At the end of the dosages, pumps are rinsed with 80 kg of demineralized water. The internal temperature is maintained at 80 °C for 1 hour. The thus obtained copolymer dispersion is then cooled down to 35°C.

[00255] Then 200 to 250 kg of soybean wax emulsion (solid content 40%) is added under stirring. The thus obtained composition IIw is then allowed to cool down to room temperature.

Coating procedure

[00256] The inventive composition IIw is applied using an Automatic Coater at 250 mm/s on white card board with a coatweight between 0 to 14 g/m² and dried at a temperature of 110°C using an IR lamp, if not reported otherwise. The best results achieved from the herein described tests are shown in the following tables.

Results**Table 8: Oil-absorbency determined according to TAPPI T441 (Cobb-Test)**

Coat Weight [g/m ²]	Cobb Oil Value (after 300 s) [g/m ²]	Cobb Oil Value (after 600 s) [g/m ²]	Cobb Oil Value (after 900 s) [g/m ²]	Cobb Oil Value (after 1200 s) [g/m ²]
0	176	ND	ND	ND
5 – 6	4	7	19	26
7 – 8	3	4	13	25
9 – 10	1.5	3	2	5
11 – 12	0.1	0.3	0.5	1
13 – 14	0.1	0.2	0.4	0.6

Table 9: Determination of oil/grease resistance according to KIT Test

Coat Weight [g/m ²]	KIT Value
0	0
5 – 6	9
7 – 8	11
9 – 10	12
11 – 12	12
13 - 14	12

CLAIMS

1. Composition for providing barrier properties, in particular liquid-resistant properties to a substrate, comprising at least components (A) and (B2), wherein (A) is at least one copolymer comprising the following monomer units
 - (A1) at least one monomer selected from styrene, methyl methacrylate, (meth)acrylonitrile, α -methyl styrene or mixtures thereof; and
 - (A2) at least one monomer comprising acrylic acid ester units; and
 - (B2) is at least one styrene maleic anhydride ester.
2. Composition according to claim 1, wherein component (A) is present in an amount in the range of from 30.0 wt% to 90.0 wt%;
component (B2) is present in an amount in the range of from 2.0 wt% to 40.0 wt%;
wherein the dry wt% of components (A) and (B2) add up to 100 wt%.
3. Method of manufacturing the composition according to at least one of the preceding claims 1 or 2 comprising at least the following step a):
 - a) Performing sub-steps i., ii., optionally iii.:
 - i.) Providing component (B2) to a first reaction area;
 - ii.) Providing at least the monomers (A1) and (A2) to a second reaction area to obtain a monomer mixture; optionally combining the monomer mixture in the second reaction area with the mixture in the first reaction area; and copolymerizing said monomer mixture to obtain component (A); or provide component (A) directly;
 - iii.) optionally mixing the composition obtained in step i. and/or the composition obtained in step ii. to provide a first copolymer mixture;

wherein optionally in any of steps a)i., a)ii., or a)iii. One or more additional components may be added to the respective mixtures.

4. Composition for providing barrier properties to a substrate, comprising at least components (A), (B1) and/or (B2) and (C), wherein

(A) is at least one copolymer comprising the following monomer units

(A1) at least one monomer selected from styrene, methyl methacrylate, (meth)acrylonitrile, α -methyl styrene or mixtures thereof; and

(A2) at least one monomer comprising acrylic acid ester units; and

(B1) is at least one styrene maleic anhydride copolymer and/or

(B2) is at least one styrene maleic anhydride ester, and

(C) is at least one elastomer and/or at least one wax, preferably at least one vegetal wax.

5. Composition according to at least one of the preceding claims claim 1 to 4 wherein the at least one monomer (A1) is present in an amount of 20.0 to 75.0 wt%, and/or the at least one monomer (A2) is present in an amount of 25.0 to 80.0 wt%, preferably wherein the at least one monomer (A1) is present in an amount of 25.0 to 65.0 wt% and/or the at least one monomer (A2) is present in an amount of 35.0 to 75.0 wt%, optionally wherein one or more further monomers (A3) may be present the copolymer in an amount of at most 5 wt%, the copolymer comprising components (A1), (A2) and optionally (A3) equaling 100 wt%.
6. Composition according to at least one of claims 1 to 5, wherein the at least one monomer (A2) is selected from alkyl acrylates or alkyl meth acrylates others than methyl methacrylate which include methyl acrylate, ethyl(meth) acrylate, butyl(meth) acrylate, iso butyl acrylate, amyl acrylate, hexyl acrylate, 2-ethylhexyl acrylate, octyl acrylate, isooctyl acrylate, decyl acrylate, dodecyl acrylates, isomers thereof, and

combinations thereof; and/or wherein the one or more further monomers (A3) are selected from (meth)acrylamide, (meth)acrylic acid, 1,3-butylene glycol dimethacrylate, 1,4-butylene glycol dimethacrylate, diethylene glycol dimethacrylate, dipropylene glycol dimethacrylate, divinyl benzene, ethylene glycol dimethacrylate, itaconic acid, N-methylol(meth)acrylamide, 4-methyl-1,4-pentanediol dimethacrylate, propylene glycol dimethacrylate, trivinyl benzene, or mixtures thereof.

7. Composition according to at least one of the preceding claims 4 to 6, wherein the at least one elastomer is selected from the group ethylene/vinyl acetate, polybutadiene, natural latexes, synthetic latexes, styrene-butadiene emulsions, or mixtures thereof; preferably wherein component (C) is natural latex or polybutadiene or mixtures thereof; and/ or wherein the vegetal wax is selected from soya wax, carnauba wax, bees wax, corn wax, coconut wax, palm oil, corn hydrogenated oil, coconut hydrogenated oil, castor hydrogenated oil, rapeseed hydrogenated oil, or combinations thereof.
8. Composition according to at least one of the preceding claims 1 to 7, wherein the composition can comprise at least one further component selected from non-ionic surfactant, ionic surfactant, pH adjusting agent, preservative, dye, pigment, defoamer, thickener, waxes, wetting agent, plasticizers, or combinations thereof.
9. Composition according to at least one of the preceding claims 1 to 8, wherein the composition is a dry composition, preferably a powder or a granulate; or wherein the composition is a liquid composition comprising a solvent, such as an organic solvent or water, preferably wherein the composition is an aqueous emulsion, an aqueous suspension, an aqueous solution, an aqueous slurry or a mixture thereof.
10. Composition according to at least one of the preceding claims 4 to 9, wherein component (A) is present in an amount in the range of from 30.0 wt% to 90.0 wt%; component (B1) and/or (B2) is present in an amount in the range of from 2.0 wt% to 40.0 wt%;

component (C): the at least one elastomer is present in an amount in the range of from 1.0 wt% to 42.0 wt% and/or the at least one wax is present in an amount in the range of from 1 % to 50 wt%

wherein the total dry wt% of the components (A), (B1) and/or (B2) and (C) add up to 100 wt%.

11. Method of manufacturing the composition according to at least one of the preceding claims 4 to 10 comprising at least the following steps a) and b):

a) Performing sub-steps i., ii., optionally iii.:

- i.) Providing component (B1) and/or (B2) to a first reaction area;
- ii.) Providing at least the monomers (A1) and (A2) to a second reaction area to obtain a monomer mixture; optionally combining the monomer mixture in the second reaction area with the mixture in the first reaction area; and copolymerizing said monomer mixture to obtain component (A); or provide component (A) directly;
- iii.) optionally mixing the composition obtained in step i. and/or the composition obtained in step ii. to provide a first copolymer mixture;

b) addition of component (C) to the first copolymer mixture obtained in step a);

wherein optionally in any of steps a)i., a)ii., a)iii. or b) one or more additional components may be added to the respective mixtures.

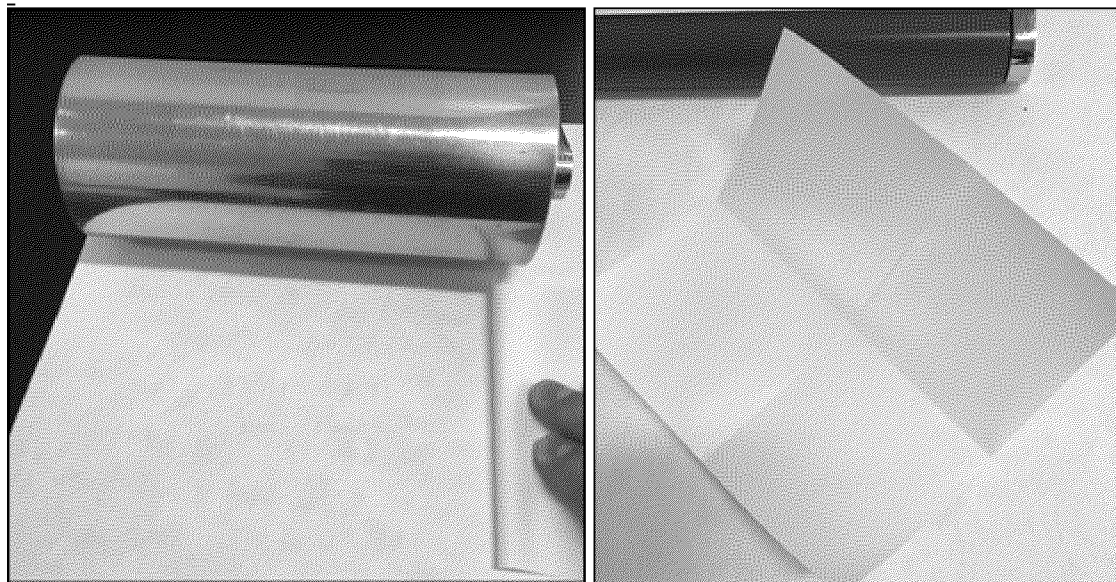
12. Use of the composition as claimed in at least one of the claims 4 to 10 or as manufactured according to the method as claimed in claim 11 as barrier, in particular oil-barrier and/or grease-barrier in case (C) is at least one elastomer the composition is further used resistance to folding; in case (C) is at least one wax the composition is also used as liquid-barrier on a substrate; preferably, wherein the substrate is a cellulose based substrate, preferably paper or cardboard, or a substrate based on synthetic polymers, like nylon; or a substrate based on natural material, like wool; or a mixture of two or more of these substrates thereof; and use of the composition as claimed in at least one of the claims 1, 2, 5 and 6, 8 and 9 or as manufactured

according to the method as claimed in claim 3 as liquid-barrier or an heat-seal on a substrate; preferably, wherein the substrate is a cellulose based substrate, preferably paper or cardboard, or a substrate based on synthetic polymers, like nylon; or a substrate based on natural material, like wool; or a mixture of two or more of these substrates thereof

13. Coated substrate, wherein the coat of the substrate comprises or consists of the composition as claimed in at least one of the claims 1 to 10 or as manufactured according to the methods as claimed in claims 3 or 11; preferably wherein the substrate is a cellulose based substrate, preferably paper or cardboard, or a substrate based on synthetic polymers, like nylon; or a substrate based on natural material, like wool; or a mixture of two or more of these substrates thereof; preferably wherein the coated substrate further comprises an overcoat selected from humidity barriers, oxygen barriers, heat sealings, gas barriers, esthetic overcoatings such as printing, varnish or to provide gloss, or combinations thereof.
14. Method of manufacturing a coated substrate as claimed in claim 13 comprising the following steps:
 - I) applying the composition as claimed in at least one of the claims 1 to 10 or as manufactured according to the method as claimed in claim 3 or 11 onto a substrate;
 - II) drying the composition as claimed in at least one of the claims 1 to 10 or as manufactured according to the method as claimed in claim 3 or 11 on the substrate.
15. Manufacturing method of an article comprising or consisting of the coated substrate as claimed in claim 13 or as manufactured according to the method as claimed in claim 14, wherein the coated substrate is subjected to measures selected from the group comprising cutting, folding, gluing, curing, dyeing, or combinations thereof.
16. Article comprising or consisting of the coated substrate as claimed in claim 13 or as manufactured according to the method as claimed in claim 14, or article manufactured according to the method as claimed in claim 15, wherein the article is a food or

beverage container, plate, straw, bags, bowls, cloths, bags (made from paper or textile).

Fig. 1: Blotter and 10kg roller for folding on the left and folded substrate on the right.



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/078734

A. CLASSIFICATION OF SUBJECT MATTER INV. D21H19/20 D21H19/58 C08L33/06 D21H17/34 D21H21/16 ADD.		
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) D21H C08F C08L Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, CHEM ABS Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
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A	column 8; example 4 claims 1,11 -----	1 - 3, 7 - 16
A	WO 2010/042162 A1 (DOW GLOBAL TECHNOLOGIES INC [US]; HARTMANN JULIA F [CH] ET AL.) 15 April 2010 (2010-04-15) page 7, paragraph 41 - page 8, paragraph 42 -----	1 - 16
A	CA 1 113 805 A (OJI PAPER CO) 8 December 1981 (1981-12-08) claims 8-10, 15 ----- - / - -	1 - 16
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* 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 23 December 2024		Date of mailing of the international search report 15/01/2025
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Mill, Sibel

INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	WO 2020/173876 A1 (TOPCHIM NV [BE]) 3 September 2020 (2020-09-03) claims 8,9,13,14 paragraph [0028] -----	1 - 16

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