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(54) **Title:** COATING COMPOSITIONS AND ARTICLES MADE THEREFROM

(57) **Abstract:** There is provided a coating composition comprising a one-part moisture-curable polyurethane comprising a polycarbonate backbone and at least one end group derived from an aliphatic isocyanate; and a liquid hydrocarbon resin, where the liquid hydrocarbon resin is non-reactive with the at least one end group derived from an aliphatic isocyanate. There are also provided articles, film, and methods of using the presently disclosed coating compositions.

COATING COMPOSITIONS AND ARTICLES MADE THEREFROM**FIELD**

5 The present disclosure relates to coating compositions. The present disclosure also relates to articles and films made using the coating compositions. The present disclosure further relates to a method for preventing water vapor transport across a surface of a structure using the coating compositions.

BACKGROUND

10 Air barrier systems control movement of air, and specifically water vapor, across a surface of a structure, such as a building enclosure. In exterior walls, uncontrolled air flow is the greatest source of moisture and condensation damage. Indoor comfort is affected by air temperature, relative humidity, direction of airflow and surrounding surface temperatures. Indoor air quality is enhanced by air barrier systems by keeping pollutants out of building interiors and is an efficient way of keeping pollutants out. 15 Pollutants include water vapor, suspended particulates, dust, insects, smells, etc. Air barrier systems have significant impact on electricity consumption and gas bills. Air barrier systems in nonresidential buildings are estimated to reduce air leakage by up to 83 percent, saving on gas bill more than 40 % and reducing electricity consumption more than 25% according to simulations by the National Institute of Standards and Technology (NIST) of typical buildings without air barriers. Water vapor is a key ingredient in corrosion and mold growth. Air barrier systems help prevent water vapor from being transported by air movement between exteriors and interiors of structures, such as buildings. 20

 Use of air barrier systems has been a requirement in Canada for almost 25 years and is becoming important in North America due to net zero energy requirements by 2030, required by the US Army Corp of Engineering, ASHRAE 90, and International Energy Conservation Code – 2009. On December 16, 25 2011, the DC Construction Codes Coordinating Board (CCCB) adopted the 2012 International Energy Conservation Code (IECC). The code now is under administrative review and legislative process, with adoption likely in the second half of 2013.

SUMMARY

30 There is a need for a coating composition that is non-permeable. There is also a need for articles, films and a method of using these coating compositions.

 In one aspect, the present disclosure provides a coating composition comprising a one-part moisture-curable polyurethane comprising a polycarbonate back bone and at least one end group derived from an aliphatic isocyanate; and a liquid hydrocarbon resin, where the liquid hydrocarbon resin is non- 35 reactive with the at least one end group derived from an aliphatic isocyanate. In some embodiments, the coating composition is a liquid at ambient conditions. In some embodiments, the coating composition comprises at least 10 wt% of components (a) and (b) based on the total weight of the coating composition.

In some embodiments, the liquid hydrocarbon resin comprises a polyisobutene. In some embodiments, the coating composition further comprises fillers. In some embodiments, the one-part moisture-curable polyurethane further comprises an aliphatic isocyanate trimer. In some embodiments, the one-part moisture-curable polyurethane further comprises a bis(oxazolidine)-based moisture-triggered isocyanate.

In some embodiments, the one-part moisture-curable polyurethane further comprises a second end group derived from an aliphatic isocyanate. The aliphatic isocyanate can be derived, in some embodiments, from ethylene diisocyanate; 1,4-tetramethylene diisocyanate; 1,6-hexamethylene diisocyanate; 2,2,4-trimethyl-1,6-hexamethylene diisocyanate; 1,12-dodecamethylene diisocyanate; 1-isocyanato-3-isocyanatomethyl-3,5,5-trimethyl-cyclohexane; bis-(4-isocyanatocyclohexyl)methane; bis-(4-isocyanato-3-methyl-cyclohexyl)methane; isophorone diisocyanate; dimer diisocyanate; m-tetramethylxylene diisocyanate; and combinations thereof. In some embodiments, the end groups are different. In some embodiments, the polycarbonate back bone has a number average molecular weight of at least 500 g/mol.

In another aspect, the present disclosure provides an article comprising a substrate coated with a coating comprising any of the presently disclosed coating compositions. In some embodiments, the coating is continuous.

In another aspect, the present disclosure provides a film comprising the presently disclosed coating composition. In some embodiments, the film has a permeability of less than 1 perms according to ASTM E 96.

In another aspect, the present disclosure provides a method of coating a substrate surface comprising applying the presently disclosed coating composition to a substrate surface and allowing it to cure. In some embodiments, the coating composition is applied at an ambient temperature of -20°C or higher.

In another aspect, the present disclosure provides a method for preventing water vapor transport across a surface of a structure comprising (a) coating at least a portion of the surface of the structure with a coating composition comprising: a one-part moisture-curable polyurethane comprising a polycarbonate back bone and at least one end group derived from an aliphatic isocyanate; and a liquid hydrocarbon resin, wherein the liquid hydrocarbon resin is non-reactive with the at least one end group derived from an aliphatic isocyanate; and (b) curing the coating composition.

Various aspects and advantages of exemplary embodiments of the present disclosure have been summarized. The above Summary is not intended to describe each illustrated embodiment or every implementation of the present disclosure. Further features and advantages are disclosed in the embodiments that follow. The Drawings and the Detailed Description that follow more particularly exemplify certain preferred embodiments using the principles disclosed herein.

DETAILED DESCRIPTION

As used in this specification, the recitation of numerical ranges by endpoints includes all numbers subsumed within that range (e.g. 1 to 5 includes 1, 1.5, 2, 2.75, 3, 3.8, 4, and 5, and the like).

Unless otherwise indicated, all numbers expressing quantities or ingredients, measurement of properties and so forth used in the Specification and embodiments are to be understood as being modified in all instances by the term "about." Accordingly, unless indicated to the contrary, the numerical parameters set forth in the foregoing specification and attached listing of embodiments can vary depending upon the desired properties sought to be obtained by those skilled in the art utilizing the teachings of the present disclosure. At the very least, and not as an attempt to limit the application of the doctrine of equivalents to the scope of the claimed embodiments, each numerical parameter should at least be construed in light of the number of reported significant digits and by applying ordinary rounding techniques.

For the following defined terms, these definitions shall be applied for the entire Specification, including the claims, unless a different definition is provided in the claims or elsewhere in the Specification based upon a specific reference to a modification of a term used in the following Glossary:
Glossary

The words "a", "an", and "the" are used interchangeably with "at least one" to mean one or more of the elements being described.

The term "layer" refers to any material or combination of materials on or overlaying a substrate.

Words of orientation such as "atop", "on", "covering", "uppermost", "overlying", "underlying" and the like for describing the location of various layers, refer to the relative position of a layer with respect to a horizontally-disposed, upwardly-facing substrate. It is not intended that the substrate, layers or articles encompassing the substrate and layers, should have any particular orientation in space during or after manufacture.

The term "separated by" to describe the position of a layer with respect to another layer and the substrate, or two other layers, means that the described layer is between, but not necessarily contiguous with, the other layer(s) and/or substrate.

The term "(co)polymer" or "(co)polymeric" includes homopolymers and copolymers, as well as homopolymers or copolymers that may be formed in a miscible blend, e.g., by coextrusion or by reaction, including, e.g., transesterification. The term "copolymer" includes random, block, graft, and star copolymers.

The term "nonpermeable" as used herein means a film having a permeability of less than 1 perms according to ASTM E 96.

As used herein, the term "aliphatic" refers to organic compounds characterized by substituted or un-substituted straight, branched, and/or cyclic chain arrangements of constituent carbon atoms. As used herein, the term "cycloaliphatic" refers to organic compounds characterized by arrangement of carbon

atoms in closed ring structures. Cycloaliphatic compounds do not contain aromatic rings as part of the molecular structure of the compounds. Hence, cycloaliphatic compounds are a subset of aliphatic compounds. Accordingly, an aliphatic composition may comprise an aliphatic compound and/or a cycloaliphatic compound. In some cases, aliphatic compounds may also contain an aromatic ring
5 provided that reactive groups in the compound are attached to an aliphatic portion of the compound and not to the aromatic portion of the compound, such as for example m-tetramethylxylene diisocyanate (meta-TMXDI).

As used herein the term "diisocyanate" refers to a compound containing two isocyanate groups. As used herein the term "polyisocyanate" refers to a compound containing two or more isocyanate
10 groups. Hence, diisocyanates are a subset of polyisocyanates.

The term "continuous" as used herein means a coating having an uninterrupted extension in along a two dimensional surface. For example, in some embodiments, an article having a continuous coating over a surface of a substrate may be a building envelope where the coating covers the entire outer surface of the building with no interruptions.

The term "liquid" as used herein means substances that have a definite volume but no fixed shape at ambient conditions. Exemplary liquids useful in the present disclosure include solutions, mixtures, emulsions and suspensions where the primary component in such solutions, mixtures, emulsions and/or
15 suspensions have a definite volume but no fixed shape at ambient conditions.

The present disclosure provides one component, moisture cure polyurethane coating compositions that are useful in air barrier systems. The presently disclosed coating compositions can be applied by spray, liquid, roller, trowel, as an article and/or a film and are non-permeable to air, water and water vapor. In some embodiments, the presently disclosed coating composition is liquid at ambient
20 conditions.

The presently disclosed coating compositions include a one-part moisture-curable polyurethane comprising a polycarbonate back bone and at least one end group derived from an aliphatic isocyanate. In some embodiments, the polycarbonate back bone has a number average molecular weight of greater than 250 g/mol, more preferably greater than 300 g/mol and most preferably greater than 500 g/mol. In some
25 embodiments, the one-part moisture-curable polyurethane includes a polyisocyanate. "Polyisocyanate" means any organic compound that has two or more reactive isocyanate (—NCO) groups in a single molecule such as diisocyanates, triisocyanates, tetraisocyanates, etc., and mixtures thereof.

Polyisocyanate also includes oligomeric or polymeric isocyanates. Cyclic and/or linear polyisocyanate molecules may usefully be employed. For improved weathering and diminished yellowing, the polyisocyanate(s) of the isocyanate component is typically aliphatic. Useful aliphatic polyisocyanates include, for example, bis(4-isocyanatocyclohexyl) methane such as available from Bayer Corp.,
30 Pittsburgh, Pa. under the trade designation "DESMODUR W"; isophorone diisocyanate (IPDI) such as commercially available from Huls America, Piscataway, N.J.; hexamethylene diisocyanate (HDI) such
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as commercially available from Aldrich Chemical Co., Milwaukee, Wis.; trimethyl hexamethylene diisocyanate such as commercially available from Degussa, Corp., Dusseldorf, Germany under the trade designation "VESTANATE TMDI"; and m-tetramethylxylene diisocyanate (TMXDI) such as commercially available from Aldrich Chemical Co., Milwaukee, Wis. In some embodiments, the polyisocyanates include derivatives of the above-listed monomeric polyisocyanates. These derivatives include, but are not limited to, polyisocyanates containing biuret groups, such as the biuret adduct of hexamethylene diisocyanate (HDI) available from Bayer Corp. under the trade designation "DESMODUR N-100", polyisocyanates containing isocyanurate groups, such as that available from Bayer Corp. under trade designation "DESMODUR N-3300" or "DESMODUR N-3900", as well as polyisocyanates containing urethane groups, uretdione groups, carbodiimide groups, allophanate groups, and the like.

In some embodiments, the one-part moisture-curable polyurethane includes a bis(oxazolidine)-based moisture-triggered isocyanate.

In some embodiments, the one-part moisture-curable polyurethane includes a polycarbonate backbone and at least two end groups derived from an aliphatic isocyanate. In some embodiments, the aliphatic isocyanate in either of the end groups is derived from at least one of ethylene diisocyanate; 1,4-tetramethylene diisocyanate; 1,6-hexamethylene diisocyanate; 2,2,4-trimethyl-1,6-hexamethylene diisocyanate; 1,12-dodecamethylene diisocyanate; 1-isocyanato-3-isocyanatomethyl-3,5,5-trimethylcyclohexane; bis-(4-isocyanatocyclohexyl)methane; bis-(4-isocyanato-3-methyl-cyclohexyl)methane; isophorone diisocyanate; dimer diisocyanate; m-tetramethylxylene diisocyanate; and combinations thereof. In some embodiments, both end groups are derived from the same aliphatic isocyanate. In some embodiments, the end groups are derived from different aliphatic isocyanates.

The presently disclosed coating compositions also include a liquid hydrocarbon resin. Hydrocarbon resin is useful to reduce moisture vapor transmittance rates for coating, articles and films made using the presently disclosed coating compositions. Useful liquid hydrocarbon resins include liquid hydrocarbon resins that are non-reactive with the at least one end group derived from aliphatic isocyanate. In some embodiments, the liquid hydrocarbon resin comprises a polyisobutene, polybutene, polybutylene and materials as such. In some embodiments, the amount of hydrocarbon resin used in the coating composition is varied to achieve desired permeability of the coating composition and articles and films made therefrom.

In some embodiments, the coating composition comprises IPDI (isophorone diisocyanate), polycarbonate prepolymer, urethane bisoxazolidine latent hardener, IPDI trimer and hydrocarbon resin. In some embodiments, the presently disclosed coating composition comprises at least 10 wt%, preferably 15 wt%, and most preferably 25 wt % of one-part moisture-curable polyurethane and hydrocarbon resin, based on the total weight of the coating composition.

Other ingredients useful in the presently disclosed coating compositions include antifoaming agents, wetting and dispersing agents, rheology modifiers, catalysts, pigments, extenders, solvents, fillers, light stabilizers and/or UV absorbers, dehydrators, and color additives.

In some embodiments, the presently disclosed coating compositions may comprise one or more additives, such as, for example, "JONCRYL(R) 611" (BASF Corporation) and/or "NEOCRYL B734" (DSM N.V.). JONCRYL(R) 611 is a styrene-acrylic acid copolymer. JONCRYL(R) 611 may be used as a dispersing agent in a moisture-curable coating composition to affect pigment dispersion and film-forming properties, for example. NEOCRYL B-734 is a methyl methacrylate, n-butyl methacrylate copolymer resin. NEOCRYL B734 may be used as a dispersing agent to affect pigment dispersion and film-forming properties, for example.

In some embodiments, the presently disclosed coating compositions may comprise one or more pigments or fillers. Useful fillers are typically solids that are non-reactive with the other components of the compositions of the invention. Useful fillers include, for example, clay, talc, dye particles, pigments and colorants (for example, TiO₂ or carbon black), glass beads, metal oxide particles, silica particles, ceramic microspheres, hollow polymeric microspheres (such as those available under the trade designation EXPANCEL 551 DE from Akzo Nobel, Duluth, Ga.), hollow glass microspheres (such as those available under the trade designation K37 from Minnesota Mining and Manufacturing Co., St Paul, Minn.), carbonates, metal oxides, silicates (e.g. talc, asbestos, clays, mica), sulfates, silicon dioxide and aluminum trihydrate.

Some specific examples include ground or light calcium carbonate (with or without a surface-treatment such as a fatty acid, resin acid, cationic surfactant, or anionic surfactant); magnesium carbonate; talc; sulfates such as barium sulfate; alumina; metals in powder form (e.g., aluminum, zinc and iron); bentonite; kaolin clay; quartz powder; and combinations of two or more.

Examples of useful organic pigments include halogenated copper phthalocyanines, aniline blacks, anthraquinone blacks, benzimidazolones, azo condensations, arylamides, diarylides, disazo condensations, isoindolinones, isoindolines, quinophthalones, anthrapyrimidines, flavanthrones, pyrazolone oranges, perinone oranges, beta-naphthols, BON arylamides, quinacridones, perylenes, anthraquinones, dibromanthrones, pyranthrones, diketopyrrolo-pyrrole pigments (DPP), dioxazine violets, copper and copper-free phthalocyanines, indanthrones, and the like.

Examples of useful inorganic pigments include titanium dioxide, zinc oxide, zinc sulphide, lithopone, antimony oxide, barium sulfate, carbon black, graphite, black iron oxide, black micaceous iron oxide, brown iron oxides, metal complex browns, lead chromate, cadmium yellow, yellow oxides, bismuth vanadate, lead chromate, lead molybdate, cadmium red, red iron oxide, Prussian blue, ultramarine, cobalt blue, chrome green (Brunswick green), chromium oxide, hydrated chromium oxide, organic metal complexes, laked dye pigments and the like.

The filler can also comprise conductive particles (see, for example, U.S. Patent Application Pub. No. 2003/0051807, which is incorporated herein by reference) such as carbon particles or metal particles

of silver, copper, nickel, gold, tin, zinc, platinum, palladium, iron, tungsten, molybdenum, solder or the like, or particles prepared by covering the surface of these particles with a conductive coating of a metal or the like. It is also possible to use non-conductive particles of a polymer such as polyethylene, polystyrene, phenol resin, epoxy resin, acryl resin or benzoguanamine resin, or glass beads, silica, graphite or a ceramic, whose surfaces have been covered with a conductive coating of a metal or the like.

Preferred fillers include inorganic solids such, for example, talc, titanium dioxide, silica, zirconia, calcium carbonate, calcium magnesium carbonate, glass or ceramic microspheres, and combinations thereof. In some embodiments, titanium dioxide and/or calcium carbonate are preferred.

In some embodiments, the coating composition of the present disclosure may comprise one or more pigment wetting agents or dispersants. Pigment wetting agents and dispersants that may be useful in the present disclosure may include, for example, DISPERBYK(R)-110 (BYK-Chemie GmbH), DISPERBYK(R)-192 (BYK-Chemie GmbH), and/or ANTI-TERRA U (BYK-Chemie GmbH).

The coating composition may comprise one or more rheology modifiers. Rheology modifiers useful in the present disclosure may include, for example, BYK(R) 430, BYK(R) 431 (BYK-Chemie GmbH), Bentonite clays, and/or castor oil derivatives. In some embodiments, the presently disclosed coating composition may comprise one or more antifoaming agents. Antifoaming agents useful in the present disclosure may include, for example, BYK(R) 077 (BYK-Chemie GmbH).

In some embodiments, the presently disclosed coating compositions may comprise one or more light stabilizers and/or UV-absorbers. Light stabilizers useful in the present disclosure may include, for example, TINUVIN(R) 292 (Ciba/BASF). UV-absorbers that may find utility in the presently disclosed coating composition may include, for example, TINUVIN(R) 1130 (Ciba/BASF). In some embodiments, the coating composition may comprise one or more dehydrators. Dehydrators useful in the presently disclosed coating composition may include, for example, p-toluenesulfonyl isocyanate, isophorone diisocyanate, and/or hexamethylene diisocyanate.

In some embodiments, the presently disclosed coating composition may comprise one or more catalysts, such as, for example, dibutyltin dilaurate or a tertiary amine, to accelerate the curing reaction. Catalysts that may find utility in the present disclosed coating composition may include, for example, DABCO(R) T-12 (Air Products and Chemicals, Inc.) and/or 1,4-diazabicyclo[2.2.2]octane. Other useful catalysts for the present disclosure include, but are not limited to, those catalysts that include both ether and morpholine functional groups, e.g., with 2,2-dimorpholinoethyl ether and di(2,6-dimethyl morpholinoethyl)ether. A useful catalyst is 4,4'-(oxydi-2,1-ethanediy) bis-morpholine, which known in the trade as DMDEE and is commercially available under the trade designation "JEFFCATE DMDEE" from Huntsman Corp. (Houston, Tex.).

Other useful catalysts include, e.g., organo tin catalysts, e.g., dibutyl tin dilaurate, and bismuth catalysts. Bismuth octoate is a very good moisture cure catalyst, but is not as stable as some catalysts during shipping and storage where the temperatures may reach about 65 °C.

The catalyst is preferably present in the presently disclosed coating composition in an amount of from about 0.05% by weight about 5% by weight, more preferably from about 0.1% by weight to about 2% by weight, most preferably from about 0.1% by weight to about 1% by weight.

The coating composition may comprise one or more additional additives. Additional additives that may find utility in the presently disclosed coating composition may include, for example, Byk(R) 358, and/or Byk(R) 306 (BYK-Chemie GmbH).

In some embodiments, the coating composition may comprise one or more solvents. Solvent should be non-reactive with isocyanate and examples of such includes aliphatic, aromatic or araliphatic solvent which do not contain any cerivitinov-active hydrogen atoms but do preferably contain ether groups and/or ester groups and/or halogen atoms and/or nitrile groups and/or amide groups. Examples of suitable solvent include methoxypropyl acetate, methoxyethyl acetate, ethylene glycol diacetate, propylene glycol diacetate, glyme, diglyme, dioxane, tetrahydrofuran, dioxolane, tert-butyl methyl ether, ethyl acetate, butyl acetate, chloroform, methylene chloride, chlorobenzene, o-dichlorobenzene, anisole, 1,2-dimethoxybenzene, phenyl acetate, N-methyl-2-pyrrolidone, dimethylformamide, N,N-dimethylacetamide, dimethyl sulphoxide, acetonitrile, phenoxyethyl acetate and/or mixtures thereof, preferably solvent containing ether and ester groups, such as methoxypropyl acetate, acetone, 2-butanone, xylene, toluene, cyclohexanone, 4-methyl-2-pentanone, 1-methoxyprop-2-yl acetate, ethylene glycol monomethyl or -ethyl ether-acetate, 3-methoxy-n-butyl acetate, white spirit, more highly substituted aromatics such as are commercially available, for example, under the names solvents Naphtha, "SOLVESSO", "ISOPAR", "NAPPAR" (Deutsche EXXON CHEMICAL GmbH, Cologne, DE) and "SHELLSOL" (Deutsche Shell Chemie GmbH, Eschborn, DE), methyl n-amyl ketone ("MAK"), "AROMATIC 100" (ExxonMobile Chemical), "AROMATIC 150" (ExxonMobile Chemical), xylene, methyl isobutyl ketone ("MIBK"), ethyl 3-ethoxypropionate (Eastman(TM) EEP solvent, Eastman Chemical Company), and/or methyl ethyl ketone ("MEK").

In some embodiments, the presently disclosed coating composition is used to make an article having a substrate coated with a coating comprising the presently disclosed coating composition. In some embodiments, the coating is continuous. In some embodiments, thickness of the coating is varied to achieve desired permeability of the article. In some embodiments, the amount of hydrocarbon resin used in the coating composition is varied to achieve desired permeability of the article. In some embodiments, the amount of hydrocarbon resin used in the coating composition and the thickness of the coating are varied to achieve desired permeability of the article.

The present disclosure provides a film made using the presently disclosed coating composition. In some embodiments, the film has a permeability of less than 1 perms according to ASTM E 96. In some embodiments, the presently disclosed films have 300 % elongation and moisture vapor transmission rates of 0 perms to 1 perms according to ASTM E 96. In some embodiments, thickness of the coating is varied to achieve desired permeability of the film. In some embodiments, the amount of hydrocarbon resin used

in the coating composition, which is used in the film, is varied to achieve desired permeability of the film. In some embodiments, the amount of hydrocarbon resin used in the coating composition and the thickness of the coating are varied to achieve desired permeability of the film.

The presently disclosed coating composition is useful in a method of coating a substrate surface including the steps of applying the presently disclosed coating composition to a substrate surface and allowing it to cure. In some embodiments, the coating composition is applied at an ambient temperature of -20°C or higher.

The present disclosure also provides a method for preventing water vapor transport across a surface of a structure including the steps of: (a) coating at least a portion of the surface of the structure with any of the presently disclosed embodiments for a coating composition; and (b) curing the coating composition. In some embodiments, the coating composition, article and/or film is applied on an exterior sheathing layer, which is commonly plywood, oriented strand board (OSB), foam insulation sheathing, nonwoven glass mat faced gypsum sheathing board, or other conventional sheathing materials commonly used in the construction industry. Useful exterior cladding layer is made up of brick, concrete blocks, reinforced concrete, stone, vinyl siding, fiber cement board, clapboard, or other known exterior siding materials. In some embodiments, the coating composition, article and/or film is applied to a roofing deck, an attic floor or other attic surface, a boundary between a wall, roof system, and/or foundation, other interior or exterior surfaces of a structure, or used as flashing around a roof penetration.

Exemplary embodiments of the present disclosure have been described above and are further illustrated below by way of the following Examples, which are not to be construed in any way as imposing limitations upon the scope of the present disclosure. On the contrary, it is to be clearly understood that resort may be had to various other embodiments, modifications, and equivalents thereof which, after reading the description herein, may suggest themselves to those skilled in the art without departing from the spirit of the present disclosure and/or the scope of the appended claims.

Following are various embodiments of the present disclosure:

1. A coating composition comprising:

- (a) a one-part moisture-curable polyurethane comprising a polycarbonate back bone and at least one end group derived from an aliphatic isocyanate; and
- (b) a liquid hydrocarbon resin

wherein the liquid hydrocarbon resin is non-reactive with the at least one end group derived from an aliphatic isocyanate.

2. The composition of embodiment 1 wherein the coating composition is a liquid at ambient conditions.

3. The composition of any of the preceding embodiments wherein the coating composition comprises at least 10 wt% of components (a) and (b) based on the total weight of the coating composition.

4. The composition of any of the preceding embodiments wherein the liquid hydrocarbon resin comprises a polyisobutene.
5. The composition of any of the preceding embodiments further comprising fillers.
- 5 6. The composition of any of the preceding embodiments wherein the one-part moisture-curable polyurethane further comprises an aliphatic isocyanate trimer.
7. The composition of any of the preceding embodiments wherein the one-part moisture-curable
10 polyurethane further comprises a bis(oxazolidine)-based moisture-triggered isocyanate.
8. The composition of any of the preceding embodiments wherein the one-part moisture-curable polyurethane further comprises a second end group derived from an aliphatic isocyanate.
- 15 9. The composition of embodiment 8 wherein the aliphatic isocyanate is derived from ethylene diisocyanate; 1,4-tetramethylene diisocyanate; 1,6-hexamethylene diisocyanate; 2,2,4-trimethyl-1,6-hexamethylene diisocyanate; 1,12-dodecamethylene diisocyanate; 1-isocyanato-3-isocyanatomethyl-3,5,5-trimethyl-cyclohexane; bis-(4-isocyanatocyclohexyl)methane; bis-(4-isocyanato-3-methyl-cyclohexyl)methane; isophorone diisocyanate; dimer diisocyanate; m-tetramethylxylene diisocyanate; and
20 combinations thereof.
10. The composition of embodiments 8 or 9 wherein the end groups are different.
11. The composition of any of the preceding embodiments wherein the polycarbonate back bone has a
25 number average molecular weight of at least 500 g/mol.
12. An article comprising a substrate coated with a coating comprising the coating composition of any of the preceding embodiments.
- 30 13. The article of embodiment 12 wherein the coating is continuous.
14. A film comprising the coating composition of any of the preceding embodiments.
15. The film of embodiment 14 wherein the film has a permeability of less than 1 perms according to
35 ASTM E 96.

16. A method of coating a substrate surface comprising applying the coating composition according to any of the preceding embodiments to a substrate surface and allowing it to cure.

17. The method of embodiment 16 wherein the coating composition is applied at an ambient temperature of -20°C or higher.

18. A method for preventing water vapor transport across a surface of a structure comprising:

(a) coating at least a portion of the surface of the structure with a coating composition comprising:

(i) a one-part moisture-curable polyurethane comprising a polycarbonate back bone and at least one end group derived from an aliphatic isocyanate; and

(ii) a liquid hydrocarbon resin

wherein the liquid hydrocarbon resin is non-reactive with the at least one end group derived from an aliphatic isocyanate; and

(b) curing the coating composition.

EXAMPLES

The following examples are intended to illustrate exemplary embodiments within the scope of this disclosure. Notwithstanding that the numerical ranges and parameters setting forth the broad scope of the disclosure are approximations, the numerical values set forth in the specific examples are reported as precisely as possible. Any numerical value, however, inherently contains certain errors necessarily resulting from the standard deviation found in their respective testing measurements. At the very least, and not as an attempt to limit the application of the doctrine of equivalents to the scope of the claims, each numerical parameter should at least be construed in light of the number of reported significant digits and by applying ordinary rounding techniques.

Materials

Designation	Description
DESMODUR LD	Solvent-free, low-viscosity liquid, low-functionality aliphatic isocyanate resin based on hexamethylenediisocyanate, obtained from Bayer Materials Science, Pittsburgh, PA
DESMODUR XP 2406	Medium-viscosity, aliphatic polyisocyanate prepolymer based on isophorone diisocyanate, approximately 80% in 1-methoxypropylacetate-2, obtained from Bayer Materials Science, Pittsburgh, PA
DESMODUR Z 4470 MPA/X	Aliphatic polyisocyanate (IPDI trimer), as hardener component, 70

	% in 1-methoxypropylacetate-2, obtained from Bayer Materials Science, Pittsburgh, PA
DESMODUR VPLS 2959	Aliphatic latent hardener, 100%, obtained from Bayer Materials Science, Pittsburgh, PA
GLISSOPAL 1000	Low molecular weight polyisobutene, obtained from BASF, Florham Park, NJ
BYK A530	Silicone polymer air release additive, obtained from BYK USA, Inc., Wallingford, CT
MPA	Methoxy propyl acetate, obtained from Sigma-Aldrich Chemical Company, St. Louis, MO
AX	Aromatic xylene, obtained from Sigma-Aldrich Chemical Company, St. Louis, MO
PTSI	<i>para</i> -toluene sulfonyl isocyanate, obtained from Sigma-Aldrich Chemical Company, St. Louis, MO
ANTI TERRA U	Wetting and dispersing additive, obtained from BYK USA, Inc., Wallingford, CT
DABCO T-12	Dibutyltindilaurate catalyst , 20% in xylene, obtained from Air Products, Inc., Allentown, PA
CAB-O-SIL TS-720	Medium surface area fumed silica which has been surface modified with polydimethylsiloxane, obtained from Cabot Corp., Billerica, MA
CLAYTONE AF	Modified montmorillonite, obtained from Southern Clay Products, Inc., Gonzales, TX
AIRWHITE ULTRA	Barium sulfate, obtained from Viaton Industries, Inc., Derbyshire, England
TIONA 696	Rutile titanium dioxide, obtained from Cristal Global, Jeddah, Saudi Arabia

Test methods

Moisture vapor transmittance rate (MVTR) of the example samples described below were determined in accordance with the ASTM E96 (2010) "Standard test method for water vapor transmission of materials", obtained from IHS Inc., Englewood, CO

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Tensile and elongation testing (conical mandrel testing) of the example samples described below were determined in accordance with the ASTM D412 (2008) "Standard test method for vulcanized rubber and thermoplastic elastomers-tension", obtained from IHS Inc., Englewood, CO

Examples 1-3 (EX1-EX3)

Each of EX1-EX3 samples were prepared from moisture cure polyurethane coating compositions made by mixing resins, pigments, specialty additives and solvents. Table 1, below summarizes the formulations for each of EX1-EX3 coating compositions. To prepare each coating composition, the desired ingredients were charged into a mixing vessel. The vessel was placed in a mixer (dual asymmetric centrifuge mixer, obtained under the trade designation "150 DAC SpeedMixer" from Flacktek, Inc Landrum, SC) and the contents were mixed at 2500 rounds per minute (rpm) for 4 minutes. The resulting slurries were then applied on a TEFLON substrate by using a drawdown coater (Multiple Clearance Applicator PA-357 with a 40 mil (1.02 mm) clearance gap, obtained from BYK Gardner GmbH, Geretsried, MD) to form a coating with about a 40 mil (1.02 mm) wet thickness. The coatings were allowed to cure at 20°C for 7 days. After curing the cured films were separated from the TEFLON substrate and the recovered cured film samples were tested. MVTR of the cured EX1-EX3 samples were determined and summarized in Table 2, below. The tensile and elongation testing of the cured EX1-EX3 samples were determined and summarized in Table 3, below.

Table 1

Ingredients of Coating Composition	Amount added (g)		
	EX1	EX2	EX3
DESMODUR LD	4.88	5.44	5.44
MPA	0.90	1.00	1.00
AX	12.00	13.37	8.37
ANTI TERRA U	0.18	0.20	0.20
BYK A530	0.45	0.50	0.50
DABCO T-12 (20 % in xylene)	1.80	0.59	0.59
CLAYTONE AF	1.78	1.98	1.98
TIONA 696	0.90	1.00	1.00
AIRWHITE ULTRA	31.40	35.00	40.00
CAB-O-SIL TS-720	0.59	0.66	0.66
DESMODUR XP 2406	26.42	29.43	29.43
GLISSOPAL 1000	8.98	0.00	0.00
PTSI	0.20	0.22	0.22
DESMODUR Z 4470 MPA/X	6.04	6.73	6.73
DESMODUR VPLS 2959	3.48	3.88	3.88
Total	100.00	100.00	100.00

Table 2

Sample	Sample Thickness (cm)	Permeance (perms)	Permeability (perm*cm)
EX1	0.083	0.05	0.004
EX2	0.051	1.20	0.061
EX3	0.058	0.60	0.035

Table 3

Sample	Width (cm)	Thickness (cm)	Strain At Break %	Modulus (MPa)	Energy To Break (N*m)	Load At Yield (N)	Strain At Yield %	Break Stress (MPa)	Elongation At Break (cm)
EX1	0.64	0.041	350.25	9.19	0.68	10.36	281.45	4.87	8.89
EX2	0.64	0.051	267.65	25.01	0.88	17.84	267.65	5.52	6.81
EX3	0.64	0.059	214.42	28.49	0.72	17.08	213.17	4.54	5.44

5 While the specification has described in detail certain exemplary embodiments, it will be appreciated that those skilled in the art, upon attaining an understanding of the foregoing, may readily conceive of alterations to, variations of, and equivalents to these embodiments. Accordingly, it should be understood that this disclosure is not to be unduly limited to the illustrative embodiments set forth hereinabove.

10 Furthermore, all publications, published patent applications and issued patents referenced herein are incorporated by reference in their entirety to the same extent as if each individual publication or patent was specifically and individually indicated to be incorporated by reference. Various exemplary embodiments have been described. These and other embodiments are within the scope of the following listing of disclosed embodiments.

What is claimed is:

1. A coating composition comprising:

(c) a one-part moisture-curable polyurethane comprising a polycarbonate back bone and at least one end group derived from an aliphatic isocyanate; and

(d) a liquid hydrocarbon resin

wherein the liquid hydrocarbon resin is non-reactive with the at least one end group derived from an aliphatic isocyanate.

2. The composition of claim 1 wherein the coating composition is a liquid at ambient conditions.

3. The composition of any of the preceding claims wherein the coating composition comprises at least 10 wt% of components (a) and (b) based on the total weight of the coating composition.

4. The composition of any of the preceding claims wherein the liquid hydrocarbon resin comprises a polyisobutene.

5. The composition of any of the preceding claims further comprising fillers.

6. The composition of any of the preceding claims wherein the one-part moisture-curable polyurethane further comprises an aliphatic isocyanate trimer.

7. The composition of any of the preceding claims wherein the one-part moisture-curable polyurethane further comprises a bis(oxazolidine)-based moisture-triggered isocyanate.

8. The composition of any of the preceding claims wherein the one-part moisture-curable polyurethane further comprises a second end group derived from an aliphatic isocyanate.

9. The composition of claim 8 wherein the aliphatic isocyanate is derived from ethylene diisocyanate; 1,4-tetramethylene diisocyanate; 1,6-hexamethylene diisocyanate; 2,2,4-trimethyl-1,6-hexamethylene diisocyanate; 1,12-dodecamethylene diisocyanate; 1-isocyanato-3-isocyanatomethyl-3,5,5-trimethyl-cyclohexane; bis-(4-isocyanatocyclohexyl)methane; bis-(4-isocyanato-3-methyl-cyclohexyl)methane; isophorone diisocyanate; dimer diisocyanate; m-tetramethylxylene diisocyanate; and combinations thereof.

10. The composition of claim 8 or 9 wherein the end groups are different.

11. The composition of any of the preceding claims wherein the polycarbonate back bone has a number average molecular weight of at least 500 g/mol.

5 12. An article comprising a substrate coated with a coating comprising the coating composition of any of the preceding claims.

13. The article of claim 12 wherein the coating is continuous.

10 14. A film comprising the coating composition of any of the preceding claims.

15. The film of claim 14 wherein the film has a permeability of less than 1 perms according to ASTM E 96.

15 16. A method of coating a substrate surface comprising applying the coating composition according to any preceding claim to a substrate surface and allowing it to cure.

17. The method of claim 16 wherein the coating composition is applied at an ambient temperature of -20°C or higher.

20 18. A method for preventing water vapor transport across a surface of a structure comprising:
(a) coating at least a portion of the surface of the structure with a coating composition comprising:

(iii) a one-part moisture-curable polyurethane comprising a polycarbonate back bone and at least one end group derived from an aliphatic isocyanate; and

25 (iv) a liquid hydrocarbon resin

wherein the liquid hydrocarbon resin is non-reactive with the at least one end group derived from an aliphatic isocyanate; and

(b) curing the coating composition.

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