Hydroxyl functional oil polyols are disclosed which can be used to produce coating compositions and coated surfaces. In some embodiments, the coating compositions are used to coat substrates such as packaging materials and the like for the storage of food and beverages. The hydroxyl functional oil polyols can be prepared by reacting an epoxidized vegetable oil with a hydroxyl functional material in the presence of an acid catalyst. Coating compositions can be prepared by crosslinking the hydroxyl functional oil polyols with a crosslinker.
HYDROXYL FUNCTIONAL OIL POLYOLS AND COATING COMPOSITIONS PREPARED FROM HYDROXYL FUNCTIONAL OIL POLYOLS

BACKGROUND OF THE INVENTION

[0001] Field of the Invention

[0002] The present invention relates to hydroxyl functional oil polyols, coating compositions formed from the hydroxyl functional oil polyols, methods of coating substrates with the coating compositions, and substrates coated with the coating compositions.

[0003] Description of Related Art

[0004] Current art is primarily based on epoxy resin technology cured with amino resins and phenolics. Coating compositions formed from bisphenol A based epoxy resins have been used to coat packaging and containers for foods and beverages. However, there is a desire among some consumers and brand owners for coating compositions free, or substantially free, of bisphenol A for packaging and containers for food and beverages.

[0005] U.S. Pat. No. 5,728,796 discloses a process which reacts an epoxide-containing compound with an aliphatic hydroxyl containing compound in the presence of a sulfonic acid catalyst. This process is used to form epoxy resins having high molecular weights.

[0006] U.S. Pat. No. 4,012,559 discloses a radiation curable coating composition having an acrylic copolymer, a polyfunctional compound having a molecular weight not greater than 2,000, and an epoxidized vegetable oil. It is explained that the cured compositions can be coated onto metal to form precoated metal products.


[0008] U.S. Patent Application Publication No. 2008/0302694 discloses a radiation curable coating composition having an epoxidized vegetable oil oligomer prepared from the reaction of an epoxidized vegetable oil and a hydroxyl functional acrylate or hydroxyl functional methacrylate in the presence of a sulfonic acid catalyst. This composition can be used as a coating for packaging materials in food storage.

[0009] U.S. Pat. No. 4,212,781 discloses processes for modifying an epoxy resin through a reaction with a copolymerizable monomer in the presence of an initiator. A graft polymer is formed from the epoxy resin by the grafting an addition polymer onto the aliphatic backbone of the epoxy resin. It is disclosed that the process is useful for making polymer blends for coating compositions.

[0010] There is a desire to produce packaging coatings that do not contain bisphenol A or are substantially free of bisphenol A. The hydroxyl functional oil polyols of the invention address this desire and can be used in the preparation of coating compositions suitable, inter alia, as packaging coatings for food and beverage packaging and containers. They can be formulated to provide higher solids for application and improved corrosion resistance compared to some commercial epoxy coating systems.

SUMMARY OF THE INVENTION

[0011] The technology of the present invention has the capability of providing better corrosion resistance and higher solids coatings than some coatings of the current art. Higher solids allows broader coating latitude in a single pass operation. The technology of the present invention may also provide high molecular weight exterior un-gelled coating compositions that are excellent film formers.

[0012] The present invention includes processes for producing hydroxyl functional oil polyols. Such processes can be performed in a single reactor or in multiple reactors. In some embodiments of the invention, a hydroxyl functional oil polyol is prepared by a method comprising the step of reacting an epoxidized vegetable oil with a hydroxyl functional material in the presence of an acid catalyst.

[0013] The present invention also includes coating compositions prepared from hydroxyl functional oil polyols. In some embodiments, the coating compositions are prepared by a method comprising reacting an epoxidized vegetable oil with a hydroxyl functional material in the presence of an acid catalyst to form a hydroxyl functional oil polyol, and crosslinking the hydroxyl functional oil polyol with a crosslinker to form the coating composition.

[0014] The present invention further includes methods of coating a substrate by mixing the hydroxyl functional oil polyol with a crosslinker to form a mixture, applying the mixture to the substrate, and crosslinking the mixture. Substrates coated with the coating compositions are also included in the present invention. In some embodiments, the substrate is a can or packaging.

DETAILED DESCRIPTION OF THE INVENTION

[0015] As used in the above-discussed embodiments and other embodiments of the disclosure and claims described herein, the following terms generally have the meaning as indicated, but these meanings are not meant to limit the scope of the invention if the benefit of the invention is achieved by inferring a broader meaning to the following terms.

[0016] Other than in the operating examples, or where otherwise indicated, all numbers expressing quantities of ingredients, reaction conditions, and so forth used in the specification and claims 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 following specification and attached claims are approximations that may vary depending upon the desired properties sought to be obtained by the present invention. 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 be construed in light of the number of significant digits and ordinary rounding approaches. Notwithstanding that the numerical ranges and parameters setting forth the broad scope of the invention are approximations, the numerical values set forth in the specific examples are reported as precisely as possible. Any numerical values, however, inherently contain certain errors necessarily resulting from the standard deviation found in their respective testing measurements. Unless stated otherwise, all percentages, ratios and proportions herein are by weight and particularly unless otherwise specifically stated, the proportions of the components in the compositions described are given in percentage pertaining to the total mass of the mixture of these components.

[0017] Also herein, the recitations of numerical ranges by endpoints include all numbers subsumed within that range (e.g., 1 to 5 includes 1, 1.5, 2, 2.75, 3, 3.80, 4, 5, etc.).
Also herein, “a,” “an,” “the,” “at least one,” and “one or more” are used interchangeably.

The terms “for example,” “without limitation” and the like, as well as the exemplary compounds, ranges, parameters and the like disclosed throughout the application and claims are intended to identify embodiments of the invention in a non-limiting manner. Other compounds, ranges, parameters and the like can be employed by those skilled in the art without departing from the spirit and scope of the invention.

The present invention includes substrates coated at least in part with a coating composition of the invention and methods for coating the substrates. The term “substrate” as used herein includes, without limitation, cans, metal cans, packaging, containers, receptacles, or any portions thereof used to hold, touch or contact any type of food or beverage. Also, the terms “substrate”, “food can(s)”, “food containers” and the like include, for non-limiting example, “can ends”, which can be stamped from can end stock and used in the packaging of food and beverages.

The present invention includes methods for preparing hydroxyl functional oil polyls and coating compositions having a hydroxyl functional oil polyol by reacting an epoxidized vegetable oil with a hydroxyl functional material in the presence of an acid catalyst. The hydroxyl functional oil polyls can be used, inter alia, in the preparation of packaging coatings. In some embodiments of the invention, the hydroxyl functional oil polyls are crosslinked with a crosslinker to form a coating composition for food and beverage packaging and containers.

The epoxidized vegetable oil can be used alone or in combination with other epoxidized vegetable oils. Epoxidized vegetable oils can be prepared from vegetable oils by, for non-limiting example, adding hydrogen peroxide and formic or acetic acid to the vegetable oil, and then holding the mixture at an elevated temperature until some or all of the carbon-carbon double bonds are converted to epoxide groups.

Vegetable oils contain primarily glycerides which are triesters of glycerol and fatty acids with varying degrees of unsaturation. For non-limiting example, epoxidized vegetable oils for use in the invention can be made from vegetable oils (fatty acid triglycerides) such as without limitation, esters of glycerol and fatty acids having an alkyl chain of about 12 to about 24 carbon atoms. Fatty acid glycerides which are triglycerides in unsaturated glyceride oils are generally referred to as drying oils or semidrying oils. Drying oils include, for non-limiting example, linseed oil, perilla oil and combinations thereof, while semidrying oils include, without limitation, tall oil, soy bean oil, safflower oil and combinations thereof. Triglyceride oils in some embodiments have identical fatty acid chains or alternatively have different fatty acid chains attached to the same glycerol molecule. In some embodiments, the oils have fatty acid chains containing non-conjugated double bonds. In some embodiments, single double bond or conjugated double bond fatty acid chains are used in minor amounts. Double bond unsaturation in glycerides can be measured by iodine value (number) which indicates the degree of double bond unsaturation in the fatty acid chains. Unsaturated fatty acid glyceride oils employed in some embodiments of the invention have an iodine value greater than about 25 and alternatively between about 100 and about 210.

Naturally occurring vegetable oils for use in the invention can be for non-limiting example, mixtures of fatty acid chains present as glycerides, and include without limitation a distribution of fatty acid esters of glyceride, where the fatty acid distribution may be random but within an established range that may vary moderately depending on the growing conditions of the vegetable source. Soybean oil is employed in some embodiments which comprises approximately about 11% palmitic, about 4% stearic, about 25% oleic, about 51% linolenic, and about 9% linoleic fatty acids, where oleic, linoleic and linolenic are unsaturated fatty acids.

Unsaturated vegetable oils employed in some embodiments of the invention include without limitation, glyceride oils containing non-conjugated unsaturated fatty acid glyceride esters such as, without limitation, linoleic and linolenic fatty acids.

Unsaturated glyceride oils include, without limitation, corn oil, cottonseed oil, grapeseed oil, hempseed oil, linseed oil, wild mustard oil, peanut oil, perilla oil, poppyseed oil, rapeseed oil, safflower oil, sesame oil, soy bean oil, sunflower oil, canola oil, tall oil, and mixtures thereof. Fatty acid glycerides for use in the invention include, for non-limiting example, those which contain linoleic and linolenic fatty acid chains, oils such as without limitation, linseed oil, perilla oil, poppyseed oil, safflower oil, soy bean oil, sunflower oil, canola oil, tall oil, grapeseed oil, rapeseed oil, corn oil, and similar oils which contain high levels of linoleic and linolenic fatty acid glycerides. Glycerides can contain lesser amounts of saturated fatty acids in some embodiments. For non-limiting example, soy bean oil can be employed which contains predominantly linoleic and linolenic fatty acid glycerides. Combinations of such oils are employed in some embodiments of the invention. Vegetable oils can by fully or partially epoxidized by known processes, such as for non-limiting example, using acids such as, without limitation, peroxo acid for epoxidation of unsaturated double bonds of the unsaturated vegetable oil. Unsaturated glyceride oils employed in some embodiments include mono-, di-, or triglycerides and mixtures thereof with tri-glycerides or fatty acid esters of saturated and unsaturated fatty acids.

In some embodiments, the epoxidized vegetable oil comprises corn oil, cottonseed oil, grape seed oil, hempseed oil, linseed oil, wild mustard oil, peanut oil, perilla oil, poppyseed oil, rapeseed oil, safflower oil, sesame oil, soy bean oil, sunflower oil, canola oil, tall oil, a fatty acid ester, monoglyceride or diglyceride of such oils, or a mixture thereof.

Commercially available sources of epoxidized vegetable oils are used in some embodiments of the invention such as, for non-limiting example, epoxidized soy oil sold under the trade designations “VIKOLOX” and “VIKOFLEX 7170” available from Arkema, Inc., “DRAPEX 6.8” available from Chemtura Corporation, and “PLAS-CHECK 775” available from Ferro Corp. Other epoxidized vegetable oils for use in the invention include, for non-limiting example, epoxidized linseed oil sold under the trade designations “VIKOFLEX 7190” available from Arkema, Inc. and “DRAPEX 10.4” available from Chemtura Corporation, epoxidized cotton seed oil, epoxidized canthamus oil and mixtures thereof. Epoxidized soy bean oil is employed in some embodiments.

In some embodiments of the invention, the hydroxyl functional material includes, without limitation, propylene glycol, ethylene glycol, 1,3-propane diol, neopentyl glycol,
trimethylol propane, diethylene glycol, a polyester glycol, a polyester, a polycarbonate, a polyolefin, a hydroxyl functional polyolefin, and mixtures thereof. The hydroxyl functional material includes an alcohol in some embodiments such as, without limitation, n-butanol, 2-ethyl hexanol, benzyl alcohol, and the like, alone, or in combination with diols or polyols.

In some embodiments, the hydroxyl functional material is present in an amount from about 2.98% to about 98.2% in a weight ratio of hydroxyl functional material to epoxidized vegetable oil, and, alternatively from about 5.95% to about 40.60%. In some embodiments, the equivalent ratio of hydroxyl functionality of hydroxyl functional material to oxirane functionality in the epoxidized vegetable oil is from about 0.1:1 to about 3:1. In some embodiments, the equivalent ratio of hydroxyl functionality to oxirane functionality in the epoxidized vegetable oil is from about 0.2:1 to about 3:1. In some embodiments, the equivalent ratio of hydroxyl functionality to oxirane functionality in the epoxidized vegetable oil is about 0.2:1.

The acid catalyst employed to facilitate the reaction of the epoxidized vegetable oil with the hydroxyl functional material can be a strong acid catalyst in some embodiments of the invention such as, for non-limiting example, one or more sulfonic acids or another strong acid (an acid with a pKa about 3 or less), a triflic acid, a triflate salt of a metal of Group IIA, IIB, IIIA, IIIB or VIIIA of the Periodic Table of Elements (according to the IUPAC 1970 convention), a mixture of said triflate salts, or a combination thereof. In some embodiments, the amount of the acid catalyst can range from about 1 ppm to about 10,000 ppm, and, alternatively, from about 10 ppm to about 1,000 ppm, based on the total weight of the reaction mixture. Catalysts include, for non-limiting example, the Group IIA metal triflate catalysts such as without limitation magnesium triflate, the Group IIB metal triflate catalysts such as without limitation zinc and cadmium triflate, the Group IIIA metal triflate catalysts such as without limitation lanthanum triflate, the Group IIIB metal triflate catalysts such as without limitation aluminum triflate, and the Group VIIIA metal triflate catalysts such as without limitation cobalt triflate, and combinations thereof. The amount of the metal triflate catalyst can range, for non-limiting example, from about 10 to about 1,000 ppm, alternatively from about 10 to about 200 ppm, based on the total weight of the reaction mixture. Some embodiments of the invention employ a metal triflate catalyst in the form of a solution in an organic solvent. Examples of solvents include, without limitation, water, alcohols such as n-butanol, ethanol, propanol, and the like, as well as aromatic hydrocarbon solvents, cycloaliphatic polar solvents such as, for non-limiting example, cycloaliphatic ketones (e.g., cyclohexanone), polar aliphatic solvents, such as, for non-limiting example, alkoxylalkanols, 2-methoxyethanol, non-hydroxyl functional solvents, and mixtures thereof.

In some embodiments, the epoxidized vegetable oil and hydroxyl functional material are heated in the presence of an acid catalyst at a temperature of about 50 to about 200°C. Optionally, a solvent can be included in the synthesis of the epoxidized vegetable oil and hydroxyl functional material to help control viscosity. In some embodiments, the solvent includes, for non-limiting example, a ketone such as, without limitation, methyl amyl ketone, an aromatic solvent such as, without limitation, xylene or Aromatic 100, an ester solvent or other non-hydroxyl functional solvent, and mixtures thereof. About 0 to about 90% of a solvent based on the total weight reaction mixture is employed in various embodiments of the invention, and alternatively about 5 to about 30% is employed. After about 2 to about 3 hours, >90% of the epoxide groups are consumed in some embodiments. Solvents selected from those described above as well as other solvents including, without limitation, hydroxyl functional solvents can be added upon cooling. In some embodiments, it is desirable to have a final NV (non-volatile content by weight) of about 30 to about 80.

In some embodiments, the hydroxyl functional oil polyol is mixed with a crosslinker to form a curable coating composition. In some embodiments, the mixture further includes a hydroxyl functional acrylic copolymer, an acid functional acrylic copolymer, a glycidyl functional acrylic copolymer, an acrylamide functional acrylic copolymer, or a mixture thereof. A non-limiting list of crosslinkers for use in the invention includes benzoguanamine, benzoguanamine formaldehyde, glycoluril, melamine formaldehyde, a phenolic crosslinker, phenol formaldehyde, urea formaldehyde, an isocyanate, a blocked isocyanate, and mixtures thereof. In various embodiments, the crosslinker to hydroxyl functional oil polyol ratio is about 1:99 to about 90:10, and alternatively about 5:95 to about 60:40. Optionally, to the mixture of the hydroxyl functional oil polyol and crosslinker a cure catalyst can be added to enhance cure. Cure catalysts include, for non-limiting example, dodecyl benzene sulfonic acid, p-toluene sulfonic acid, and the like, as well as mixtures thereof. In some embodiments, other polymers that may be blended into the coating composition, such as without limitation, polyethers, polyesters, polycarbonates, polyurethanes and the like, as well as mixtures thereof. Cure conditions for packaging coatings in some embodiments are about 10 to about 60 seconds at about 500°F to about 600°F, and alternatively about 1 minute to about 20 minutes at about 250°F to about 500°F. In some embodiments, additives commonly used in formulating thermally cured coatings are employed, such as without limitation, solvents and slip aids.

The hydroxyl functional oil polyols and the coating compositions of the invention include conventional additives known to those skilled in the art, such as, without limitation, flow agents, surface active agents, defoamers, anti-cratering additives, lubricants, heat-release additives, and cure catalysts.

The hydroxyl functional oil polyols can be used to form thermally curable coating compositions. It is thought that the hydroxyl functionality of the hydroxyl functional oil polyol is reactive with conventional crosslinkers, such as melamine and phenolic materials. Hydroxyl functional compounds that are also (meth)acrylate functional are not preferred materials for the preparation of hydroxyl functional oil polyols for thermal curing.

In some embodiments of the invention, one or more coating compositions are applied to a substrate, such as for non-limiting example, cans, metal cans, packaging, containers, receptacles, can ends, or any portions thereof used to hold or touch any type of food or beverage. In some embodiments, one or more coatings are applied in addition to the coating compositions of the present invention, such as for non-limiting example, a prime coat may be applied between the substrate and the coating composition.
The coating compositions can be applied to substrates in any manner known to those skilled in the art. In some embodiments, the coating compositions are sprayed or roll coated onto a substrate.

For some applications, solvent borne polymeric solutions can contain, for non-limiting example, between about 20% and about 60% by weight polymer solids. Organic solvents are utilized in some embodiments to facilitate roll coating or other application methods and such solvents can include, without limitation, n-butanol, 2-butoxy-ethanol-1, xylene and other aromatic solvents and ester solvents, and mixtures thereof. In some embodiments, n-butanol is used in combination with 2-butoxy-ethanol-1. The coating compositions of the present invention can be pigmented and/or opacified with known pigments and opacifiers in some embodiments. For many uses, including food use for non-limiting example, the pigment can be zinc oxide, carbon black, or titanium dioxide. The resulting coating compositions are applied in some embodiments by conventional methods known in the coating industry. Thus, for non-limiting example, spraying, rolling, dipping, and flow coating application methods can be used for both clear and pigmented films. In some embodiments, after application onto a substrate, the coating composition is thermally cured at temperatures in the range of about 130°C to about 250°C, and alternatively higher for time sufficient to effect complete curing as well as volatilizing any fugitive components.

EXAMPLES

The invention will be further described by reference to the following non-limiting examples. It should be understood that variations and modifications of these examples can be made by those skilled in the art without departing from the spirit and scope of the invention.

Example 1
Preparation of Hydroxyl Functional Oil Polyol

11.0 grams of propylene glycol, 112.0 grams of epoxidized soy bean oil, 30.9 grams of methyl amyl ketone and 0.036 grams of Nacre A-218 (available from King Industries) were stirred under nitrogen and warmed to 150°C. The initial exotherm was controlled at <155°C, and the mixture was held at 150°C for about 2 hours then cooled. Oxirane titration indicated >99.9% conversion of the epoxide groups.

Example 2
Preparation of Hydroxyl Functional Oil Polyol

50.9 grams of diethylene glycol and 150 grams of epoxidized soy bean oil were added to a 1 liter flask. 0.02 grams of Nacre A-218 (available from King Industries) was added to the flask at 20°C, and the mixture was stirred under nitrogen and warmed to 160°C. The initial exotherm was controlled at <165°C, and the mixture was held at 160°C for about 3 hours. Oxirane titration indicated >99.9% conversion of the epoxide groups. 50.3 grams of butyl cellosolve was added on cool down to give 80% NV.

Example 3
Preparation of Hydroxyl Functional Oil Polyol

50.0 grams of neopentyl glycol and 150 grams of epoxidized soy bean oil were added to a 1 liter flask. 0.02 grams of Nacre A-218 (available from King Industries) was added to the flask at 20°C, and the mixture was stirred under nitrogen and warmed to 160°C. The initial exotherm was controlled at <165°C, and the mixture was held at 160°C for about 3 hours. Oxirane titration indicated >99.9% conversion of the epoxide groups. 50.3 grams of butyl cellosolve was added on cool down to give 80% NV.

Example 4A
Preparation of Hydroxyl Functional Oil Polyol

185.500 grams of propylene glycol, 812.450 grams of epoxidized soy bean oil and 0.206 grams of Nacre A-218 (available from King Industries) were stirred under nitrogen and warmed to 150°C. (141 grams of propylene glycol remained as unreacted solvent). The initial exotherm was controlled at <155°C, and the mixture was held at 150°C for about 2 hours then cooled. Oxirane titration indicated >99.9% conversion of the epoxide groups.

Example 5
Preparation of Hydroxyl Functional Oil Polyol

150.0 grams of epoxidized soy bean oil, 36.8 grams of trimethylol propane, and 46.7 grams of methyl amyl ketone were added to a 1 liter flask. 0.02 grams of Nacre A-218 (available from King Industries) was added to the flask at 20°C, and the mixture was stirred under nitrogen and warmed to 150°C. The initial exotherm was controlled to 153°C, and the mixture was held at 150°C for about three hours, then cooled. Oxirane titration indicated >99.9% conversion of the epoxide groups.

Example 6
Preparation of Glycidyl Functional Acrylic Copolymer

1253 grams of butyl cellosolve was charged to a five liter glass flask and heated and stirred under nitrogen to 100°C. A mixture of 450 grams of glycidyl methacrylate, 525 grams of butyl acrylate, 525 grams of methyl methacrylate, and 75 grams of tertiary butyl peroxide was added over a period of three hours, while the flask contents were maintained at 110°C. An additional 137 grams of butyl cellosolve was then added to the flask, while the temperature was allowed to fall to 95°C. A mixture of 150 grams of butyl cellosolve and 25 grams of tertiary butyl peroxide was then added over 30 minutes. The flask was then held at 95°C for 60 minutes, and then cooled.

Example 7
Preparation of Coating Composition

A blend was made consisting of 76.14 pounds of the resin from Example 5; 57.9 pounds of the resin from Example 6; 85.7 pounds of RSO199, a phenolic resin available from Cytec Industries; 17.04 pounds of Santolink EP500, a phenolic resin available from Cytec Industries; 10.7 pounds of Cymel 27-809, a benzoguanamine resin available from Cytec Industries; 6.06 pounds of Lanco Gildr TPG 087, a dispersion of carnauba wax in solvent available from Luberzol Advanced Materials; 4.6 pounds of a dispersion consisting of 30 parts of MPP-620XF, a polyethylene wax available from Micro Powders, Inc.; in 70 parts of butyl cellosolve; 0.387 pounds of...
Coroc A-620-A2, an acrylic flow agent available from Cook Composites and Polymers; and 16.4 pounds of butyl cello-
solve.

What is claimed is:
1. A coating composition comprising a hydroxyl functional oil polyol prepared by a method comprising reacting an epoxidized vegetable oil with a hydroxyl functional material in the presence of an acid catalyst.
2. The coating composition of claim 1, wherein the epoxi-
dized vegetable oil comprises corn oil, cottonseed oil, grape-
seed oil, hempseed oil, linseed oil, wild mustard oil, peanut
oil, perilla oil, poppyseed oil, rapeseed oil, safflower oil,
sesame oil, soy bean oil, sunflower oil, canola oil, tall oil,
a fatty acid ester, monoglyceride or diglyceride of such oils, or
a mixture thereof.
3. The coating composition of claim 1, wherein the epoxi-
dized vegetable oil is derived from an unsaturated fatty acid
glyceride.
4. The coating composition of claim 1, wherein the epoxi-
dized vegetable oil is present in an amount from about 2 to
about 98 parts based on the total weight of the hydroxyl functional oil polyol.
5. The coating composition of claim 1, wherein the hydroxyl functional material comprises propylene glycol, 1,3-propone diol, ethylene glycol, neopentyl glycol, trim-
ethylol propane, diethylene glycol, a polyether glycol, benzyl
alcohol, 2-ethyl hexanol, a polyester, a polycarbonate, a
hydroxyl functional polyolefin, or a mixture thereof.
6. The coating composition of claim 1, wherein the equiva-
 lent ratio of hydroxyl functionality of the hydroxyl functional
to oxirane functionality in the epoxidized vegetable oil is
from about 2:1 to about 3:1.
7. The coating composition of claim 1, wherein the acid
catalyst comprises a strong acid, such as a sulfuric acid, a
triflic acid, a triflate salt of a metal of Group II A, II B, III A,
III B or VII A of the Periodic Table of Elements (according
to the IUPAC 1970 convention), a mixture of said triflate salts,
or a combination thereof.
8. The coating composition of claim 1, wherein the reaction of the epoxidized vegetable oil and the hydroxyl functional material is conducted in the presence of a solvent.
9. The coating composition of claim 8, wherein the solvent
comprises a ketone, an aromatic solvent, an ester solvent, a
non-hydroxyl functional solvent, or a mixture thereof.
10. The coating composition of claim 1, wherein the hydroxyl functional oil polyol of claim 1 is reacted with a crosslinker to form the coating composition.
11. The coating composition of claim 10, wherein the crosslinker comprises phenol-formaldehyde, melamine
formaldehyde, urea formaldehyde, benzoguanamine formu-
dehyde, a blocked isocyanate, or a mixture thereof.
12. The coating composition of claim 11, further comprising
a hydroxyl functional acrylic copolymer, an acid func-
tional acrylic copolymer, a glycidyl functional acrylic copolymer, an acrylamide functional acrylic copolymer, or a
mixture thereof.
13. A coating composition prepared by a method comprising
reacting an epoxidized vegetable oil with a hydroxyl
functional material in the presence of an acid catalyst to form
a hydroxyl functional oil polyol, and crosslinking the
hydroxyl functional oil polyol with a crosslinker to form the
coating composition.
14. A method of coating a substrate comprising:
a) preparing a coating composition by a method compris-
ing reacting an epoxidized vegetable oil with a hydroxyl
functional material in the presence of an acid catalyst to
form a hydroxyl functional oil polyol;
b) mixing the hydroxyl functional oil polyol with a
crosslinker to form a mixture;
c) applying the mixture to the substrate; and
d) crosslinking the mixture.
15. A substrate coated with the coating composition of
claim 1.
16. A coating composition comprising a hydroxyl func-
tional oil polyol prepared by a method comprising reacting an epoxidized vegetable oil with a hydroxyl functional material in the presence of an acid catalyst to form a hydroxyl functional oil polyol, wherein the equivalent ratio of hydroxyl functionality of the hydroxyl functional material to oxirane functionality in the epoxidized vegetable oil is from about 0.2:1 to about 3:1.
17. The hydroxyl functional oil polyol of claim 16, wherein
the hydroxyl functional material comprises propylene glycol, 1,3-propone diol, ethylene glycol, neopentyl glycol, trim-
ethylol propane, diethylene glycol, a polyether glycol, benzyl
alcohol, 2-ethyl hexanol, a polyester, a polycarbonate, a
hydroxyl functional polyolefin, or a mixture thereof.
18. The hydroxyl functional oil polyol of claim 16, wherein
the acid catalyst comprises a strong acid, such as sulfuric
acid, a triflic acid, a triflate salt of a metal of Group II A, II B,
III A, II B or VII A of the Periodic Table of Elements (accord-
ing to the IUPAC 1970 convention), a mixture of said triflate salts,
or a combination thereof.
19. A coating composition prepared by crosslinking the
hydroxyl functional oil polyol of claim 16 with a crosslinker
to form the coating composition.
20. A method of coating a substrate comprising:
a) preparing a coating composition by a method compris-
ing reacting an epoxidized vegetable oil with a hydroxyl
functional material in the presence of an acid catalyst to
form a hydroxyl functional oil polyol, wherein the equiva-
lent ratio of hydroxyl functionality to oxirane functionality in the epoxidized vegetable oil is from about 0.2:1 to about 3:1;
b) mixing the hydroxyl functional oil polyol with a
crosslinker to form a mixture;
c) applying the mixture to the substrate; and
d) crosslinking the mixture.
21. A substrate coated with the coating composition of
claim 20.

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