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Title: UV CURED HIGH ALPHA LINOLENIC ACID LINSEED OIL EPOXY

Abstract: An epoxy composition comprising an epoxy-modified fatty acid resin, a catalyst and a curing agent can be used as anti-graffiti coating, a floor coating, a concrete sealant, a natural stone sealant, a coating for boats and other marine applications, inks, corkboard epoxy, cardboard epoxy, fiberglass epoxy, metal epoxy, a rubber flooring, a floor adhesive, a linoleum adhesive, a carpet adhesive etc. The compositions have improved cure time, hardness and chemical resistance and also do not contain or emit significant or any volatile organic compounds.
UV CURED HIGH ALPHA LINOLENIC ACID LINSEED OIL EPOXY

PRIOR APPLICATION INFORMATION

The present application claims the benefit of US Provisional Patent Application 61/038,284, filed March 20, 2008.

FIELD OF THE INVENTION

The invention relates to natural oil based epoxies. More specifically, the invention relates to ultraviolet radiation cured, non-volatile organic component, linseed oil based epoxy coatings, sealants, adhesives and elastomers. High alpha linolenic acid linseed oil based epoxies, according to the present invention, can be quickly cured by a process including exposure to ultraviolet radiation to form coatings, sealants, adhesives and elastomers which do not contain and will not emit volatile organic components.

BACKGROUND OF THE INVENTION

Existing epoxy coating, seaiant, adhesive and elastomer compositions can contribute to volatile organic component emissions and also have slow cure times, lack hardness and chemical resistance. For example, one or two component epoxy coatings may be low-voc or no-voc but have a cure time of several days. Furthermore, existing epoxy compositions may comprise of chemicals which are harmful to the environment.

Therefore, there is a significant need in the epoxy industry for versatile, environmentally friendly, natural oil based epoxy compositions with improved cure time, hardness and chemical resistance and which do not also contain volatile organic components (NO-VOC).

SUMMARY OF THE INVENTION

The present invention provides compositions that in some embodiments include an epoxy-modified fatty acid ester, an ultraviolet radiation photoinitiator, a curing agent and a catalyst. In certain embodiments the composition is useful as an
anti-graffiti coating, a floor coating, a concrete sealant, a natural stone sealant, a coating for boats and other marine applications, inks, corkboard epoxy, cardboard epoxy, fiberglass epoxy, metal epoxy, a rubber flooring, a floor adhesive, a linoleum adhesive, a carpet adhesive as well as other suitable uses which will be readily apparent to one of skill in the art. Compositions of the present invention may be present as one component, two component or optionally three components.

In certain embodiments of the composition the epoxy modified fatty acid ester is epoxidized high alpha linolenic acid linseed oil known in trade as epoxidized HIOMEGA™ linseed oil. As discussed herein, a 'high alpha linolenic acid linseed oil' such as HIOMEGA has at least 60% and preferably 70-80% alpha linolenic acid content.

In certain embodiments of the composition the epoxy modified fatty acid ester is a combination of epoxidized high alpha linolenic acid linseed oil known in trade as epoxidized HIOMEGA linseed oil and an epoxy modified fatty acid ester selected from the group consisting of epoxidized high alpha linolenic acid unseed oil known in trade as epoxidized HiOMEGA linseed oil, epoxidized low linoienic acid linseed oil known in trade as epoxidized linseed oil, epoxidized soybean oil and combinations thereof.

In certain embodiments of the composition the ultraviolet radiation sensitive photoinitiator is a cationic ammonium salt.

In certain embodiments of the composition the curing agent or hardener is an anhydride or mixture of anhydrides.

In certain embodiments of the composition the catalyst is a polybasic acid.

In certain embodiments of the composition the optional third component is a filler or inert ingredient or material.

According to a first aspect of the invention, there is provided a composition for coatings, adhesives, sealants and elastomers comprising an epoxy-modified fatty acid resin, a catalyst and a curing agent.

The epoxy-modified fatty acid resin may be an epoxidized natural vegetable oil selected from the group consisting of epoxidized high alpha linolenic acid linseed oil, epoxidized low alpha linolenic acid linseed oil, epoxidized soybean oil and
combinations thereof.

The composition may comprise 91-99% epoxy-modified fatty acid resin, 0.5-8.5% catalyst and 0.5-8.5% curing agent.

The catalyst may be an ultraviolet radiation induced photoinitiator. The ultraviolet radiation induced photoinitiator may be an onium salt cationic photoinitiator. The ultraviolet radiation induced photoinitiator may be selected from the group consisting of bis (dodecylphenyl) iodonium hexafluoroantimonate, triarylsulphoniumhexafluorophosphate, bis triphenyl sulphonium hexafluorophosphate and 4,4'-dimethyl-diphenyl iodonium hexafluorophosphate or combinations thereof.

The composition may comprise:

a first component comprising 96-100% epoxy-modified fatty acid resin and 0-4% UV radiation induced photoinitiator; and

a second component comprising 55-85% curing agent and 15-45% catalyst.

The composition may include a third component comprising a filler or an inert material.

The curing agent may be at least one anhydride.

The at least one anhydride may be selected from the group consisting of methyl tetrahydrophthalic anhydride, pyromellitic anhydride and combinations thereof.

The catalyst may be a dibasic acid, for example, maleic acid.

The filler or inert material may be selected from the group consisting of calcium phosphate, shredded recycled rubber, ground rubber in both round cold milled form and fine flake, clay, glass beads, calcium carbonate, talc, silica and the like and combinations thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which the invention belongs. Although any methods and materials similar or equivalent to those described herein can be used in the practice or testing of the present invention, the preferred methods and materials are now described. All publications mentioned hereunder are incorporated herein by reference.
As used herein, "a," "an," "the," "at least one," and "one or more" are used interchangeably.

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, the recitations of ratio ranges by endpoints include all ratios and fractional ratios subsumed within that range (e.g., 1:10 to 1:100 includes 1:20, 1:35, 1:75.5 etc).

Also herein, the terms "comprises" and variations thereof do not have a limiting meaning where these terms appear in the description and claims.

As used herein, the term "iodine value" is used to indicate the amount of unsaturation in the form of double bonds contained by the fatty acids of a natural vegetable oil. The higher the iodine value, the more unsaturated double bonds are present in the fatty acids of the triglycerides of the oil.

As used herein, the term "high alpha linolenic acid linseed oil" refers to the natural linseed oil with at least 60 % alpha linolenic acid content and more commonly with 70% to 80 % alpha linolenic acid content. Furthermore, as used here, the term "high alpha linolenic acid linseed oil" refers to the natural linseed oil with an iodine value typically ranging from 200 to 250. An exemplary example of a high alpha linolenic acid linseed oil is HIOMEGA, as discussed herein.

As used herein, the term "low alpha linolenic acid linseed oil" refers to the natural linseed oil with at least 45% and not more than 60 % alpha linolenic acid content. Furthermore, as used herein, the term "low alpha linolenic acid linseed oil" refers to the natural linseed oil with iodine values typically ranging from 170 - 200. An exemplary example of a low alpha linolenic acid linseed oil is Lankroflex™, as discussed herein.

As used herein, the term "soybean oil" refers to the natural vegetable oil derived from soybeans with a typical iodine value from 125 - 140. An exemplary example of an expoxidized soybean oil is PARAPLEX G-60+TIW.
As used herein, the term "oxirane value" is defined as the percent oxygen absorbed by the unsaturated natural oil raw material during oxidation (Whittington’s Dictionary of Plastics, James F. Carley, Ed., Technomic Publishing Co., Lancaster PA., 1993).

As used herein, the term "epoxy-modified fatty acid ester resin" refers to a fatty acid resin that has been epoxidized.

As used herein, the term "epoxidized high alpha linolenic acid linseed oil" refers to high alpha linolenic acid linseed oil which has been epoxidized to yield an epoxidized natural oil or epoxidized fatty acid ester with an oxirane value as high as 10 to 15.

As used herein, the term "epoxidized low alpha linolenic acid linseed oil" refers to low alpha linolenic acid linseed oil which has been epoxidized to yield an epoxidized natural oil or epoxidized fatty acid ester with an oxirane value typically ranging from 7 to 10.

As used herein, in the term "epoxidized soybean oil" refers to soybean oil which has been epoxidized to yield an epoxidized natural oil or epoxidized fatty acid ester with an oxirane value typically ranging from 5.5 to 7.1.

Described herein is a composition comprising an epoxy-modified fatty acid resin, a catalyst and a curing agent. As discussed herein, the composition may be used in a variety of ways, for example but by no means limited to as anti-graffiti coating, a floor coating, a concrete sealant, a natural stone sealant, a coating for boats and other marine applications, inks, corkboard epoxy, cardboard epoxy, fiberglass epoxy, metal epoxy, a rubber flooring, a floor adhesive, a linoleum adhesive, a carpet adhesive etc. As discussed herein, the compositions described herein have improved cure time, hardness and chemical resistance and also do not contain or emit significant or any volatile organic compounds. Accordingly, these epoxy compositions are characterized in that no volatile organic compounds are emitted therefrom.

In some embodiments, the catalyst is an ultraviolet radiation induced photo initiator. In these embodiments, the composition is referred to as a 'one
component’ composition in which the composition may be applied directly to the use site and UV light is used to initiate cross-linking. That is, in these embodiments, the composition is ready for immediate use and curing is effected by using either natural sunlight or a UV source, as discussed herein.

In other embodiments, referred to as ‘two component’ compositions, there is provided a first component comprising an epoxy-modified fatty acid resin and a second component comprising a curing agent and a catalyst. In these embodiments, the first component and the second component are mixed together at an appropriate ratio as discussed herein immediately prior to application to the use site.

In yet further embodiments, referred to as ‘three component’ compositions, there is provided an additional third component comprising filler which is mixed at an appropriate ratio with the other two components to produce the desired composition which is then applied to the use site as discussed herein.

As will be appreciated by one of skill in the art, there are also provided within the invention kits comprising the first component, the first component and the second component and the first component, the second component and the third component together with instructions describing the proper modes of mixing where applicable.

The above-described compositions provide fast-curing coatings, sealants, adhesives and elastomers which do not contain and will not emit volatile organic components. As discussed herein, the seal is chemical resistant, hard and durable.

That is, in some embodiments, compositions of the present invention include an epoxy-modified fatty acid resin, an ultraviolet radiation induced photoinitiator, a curing agent and a catalyst.

Compositions may be one component, two components or optionally three components, as discussed herein. As will be appreciated by one of skill in the art, this provides considerable flexibility on how the compositions can be used and cured.

A one component composition preferably includes an epoxy-modified fatty acid resin, an ultraviolet radiation induced photoinitiator and a curing agent. As discussed above, in these embodiments, the ultraviolet radiation induced photoinitiator is the catalyst and the composition is arranged to be applied directly to the use site without
any prior mixing. As discussed herein, crosslinking is initiated by UV radiation, either natural (sunlight) or man-made (UV light). As discussed below, the specific wavelength or range of wavelengths of UV light used depends on the photoinitiator selected.

In these embodiments, the one component composition comprises 91-99% epoxy-modified fatty acid resin, 0.5%-8.5% curing agent and 0.5%-8.5% catalyst, for example, an ultraviolet radiation induced photoinitiator.

A two component composition preferably includes an epoxy-modified fatty acid resin and optionally an ultraviolet radiation induced photoinitiator in the first component (Component A) and a curing agent and catalyst in the hardener or second component (Component B).

In these embodiments, the first component or component A comprises 96-100% epoxy-modified fatty acid resin plus 0-4% photoinitiator. The second component or component B comprises 55-85% curing agent and 15-45% catalyst.

A three component composition preferably includes an epoxy-modified fatty acid resin and optionally an ultraviolet radiation induced photoinitiator in the first part (Component A) and a curing agent and catalyst in the hardener or second part (Component B) and a filler or inert ingredient or material in the third part (Component C). As will become apparent to one of skill in the art, the addition of the third component or component C at varying concentrations allows for the formation of very different textures and properties as discussed herein.

As discussed herein, the compositions provide versatile, environmentally friendly, natural oil based epoxy compositions with improved cure time, hardness and chemical resistance, which do not also contain volatile organic components (NO-VOC).

In the compositions of the present invention the epoxy modified fatty acid resin is present in an amount suitable to form a hardened composition through polymerization. Typically, photoinitiated polymerization of the epoxy modified fatty acid resin proceeds rapidly to form a chemical resistant, durable and hard substance.
In a one component composition, preferably, an epoxy-modified fatty acid ester resin is present in the overall composition in an amount of at least 91 weight percent (wt-%, based on total weight of solids of the epoxy-modified fatty acid ester resin, ultraviolet radiation induced photoinitiator, and the curing agent in the overall composition).

Preferably, an epoxy-modified fatty acid ester resin is present in the overall composition in an amount of no more than 99 wt-%, even more preferably, no more than 98 wt-%, even more preferably, no more than 97 wt-%, even more preferably, no more than 96 wt-%, even more preferably, no more than 95 wt-%, even more preferably, no more than 94 wt-%, even more preferably, no more than 93 wt-%, even more preferably, no more than 92 wt-% and even more preferably, no more than 91 wt-%.

In a two component composition, preferably, an epoxy-modified fatty acid ester resin is present in the first part (Component A) of the composition in an amount of at least 96 weight percent (wt-%, based on total weight of solids of the epoxy-modified fatty acid ester resin and ultraviolet radiation sensitive photoinitiator of Component A).

Preferably, an epoxy-modified fatty acid ester resin is present in the first part (Component A) composition in an amount of no more than 100 wt-%, even more preferably, no more than 99 wt-%, even more preferably, no more than 98 wt-%, even more preferably, no more than 97 wt-% and even more preferably, no more than 96 wt-%.

Furthermore, in a two component composition, preferably, the ratio by weight of the first component (Component A) to the hardener or second component (Component B) is at least 1:1, or even more preferably, at least 1.2:1, or even more preferably, at least 1.3:1, or even more preferably, at least 1.4:1, or even more preferably, at least 1.5:1, or even more preferably, at least 1.6:1 and even more preferably, at least 1.7:1. Preferably, in a two component composition, the ratio of the first component (Component A) to the hardener or second component (Component B) is no more than 4:1, or even more preferably, no more than 3:1, or more preferably no more than 2:1.
In a three component composition, preferably, an epoxy-modified fatty acid ester resin is present in the first part (Component A) of the composition in an amount of at least 96 weight percent (wt-%, based on total weight of solids of the epoxy-modified fatty acid ester resin and ultraviolet radiation sensitive photoinitiator of Component A). Preferably, an epoxy-modified fatty acid ester resin is present in the first part (Component A) composition in an amount of no more than 100 wt-%, even more preferably, no more than 99 wt-%, even more preferably, no more than 98 wt-%, even more preferably, no more than 97 wt-% and even more preferably, no more than 96 wt-%.

Furthermore, in a three component composition, preferably, the ratio by weight of the first component (Component A) to the hardener or second component (Component B) is at least 1:1, or even more preferably, at least 1.2:1, or even more preferably, at least 1.3:1, or even more preferably, at least 1.4:1, or even more preferably, at least 1.5:1, or even more preferably, at least 1.6:1 and even more preferably, at least 1.7:1. Preferably, in a two component composition, the ratio of the first component (Component A) to the hardener or second component (Component B) is no more than 4:1, or even more preferably, no more than 3:1 and even more preferably, no more than 2:1.

As discussed above, in some embodiments, a third component is available for addition to the first component and the second component for use in some applications. For example, in a three component composition, preferably, the ratio by weight of the filler or third component (Component C) and the combined weights of the first component (Component A) and hardener or second component (Component B) is at least 1:100, or even more preferably at least 1:10, or even more preferably at least 1:1 and even more preferably, at least 10:1. Preferably, in a three component composition, the ratio by weight of the filler or third component (Component C) and the combined weights of the first component (Component A) and hardener or second component (Component B) is no more than 100:1, or even more preferably, is no more than 50:1, or even more preferably, is no more than 40:1, or even more preferably, is no more than 30:1, or even more preferably, is no more than 20:1 and
even more preferably, is no more than 10:1. As will be appreciated by one of skill in the art, the third component, while referred to as 'filler', provides the user with a significant degree of flexibility when using the three components for preparing adhesive compositions having very different textures and properties which can quickly and easily be mixed and used.

Preferably, the epoxy modified fatty acid ester is epoxidized high alpha linolenic acid linseed oil known in trade as epoxidized HiOMEGA linseed oil. Other suitable epoxy modified fatty acid esters may be a combination of epoxidized high alpha linolenic acid linseed oil and other suitable epoxy modified fatty acid ester resins derived from natural vegetable sources.

Specifically, epoxidized high alpha linolenic acid linseed oil is preferred as the high oxirane value indicates a high number of epoxy functional groups. The greater the number of epoxy groups, the greater the opportunity for crosslinking and the faster polymerization will occur to yield a quick curing, durable and hard composition.

Suitable epoxy modified fatty acid ester resins may have, for example, an oxirane value of 5.5 to 15. Preferably, epoxy modified fatty acid ester resins with highest oxirane values would be used in compositions of the present invention.

Suitable epoxy modified fatty acid ester resins would be derived from unsaturated natural vegetable oils with typical iodine values of 125 to 250. Preferably, epoxy modified fatty acid ester resins from natural vegetable oils with the highest iodine values would be used in compositions of the present invention.

Suitable epoxy-modified fatty acid ester resins for use in the present invention may include, for example, epoxidized natural oils, such as epoxidized high alpha linolenic acid linseed oil, epoxidized low alpha linolenic acid linseed oil, soybean oil and the like. Examples of epoxy-modified fatty acid ester resins are those sold under the trade designations epoxidized HIOMEGA linseed oil, an epoxidized high alpha linolenic acid content linseed oil (Polar Industries, Fisher Branch, Manitoba Canada), PARAPLEX G-60 epoxidized soybean oil (CP Ha!!l, Chicago, Ill.), LANKROFLEX L epoxidized linseed oil (Akros Chemicals, New Brunswick, N.J.). A particularly preferred epoxy modified fatty acid ester resin is the epoxidized high alpha linolenic
acid linseed oil known in trade as epoxidized HiOMEGA linseed oil (Polar Industries, Inc. Fisher Branch, Manitoba Canada).

Combinations of the above-described epoxy modified fatty acid ester resins are also suitable for use in the present invention. Preferably combinations of the above-described epoxy-modified fatty acid ester resins which contain at least 10 % epoxidized high alpha-linoSenic acid linseed oil. Even more preferably, combinations of the above-described epoxy-modified fatty acid resins contain 100 % epoxidized high alpha linolenic acid linseed oil.

An ultraviolet radiation induced photoinitiator is preferably present in the overall composition to initiate polymerization and cross-linking.

In a one component composition an ultraviolet radiation sensitive photoinitiator is preferably present in 1 weight percent (wt-%, based on total weight of solids of the epoxy-modified fatty acid ester resin, ultraviolet radiation sensitive photoinitiator, and the curing agent in the overall composition), more preferably, at least 2 wt-%, even more preferably, at least 3 wt-% and even more preferably, at least 4 wt-%. Preferably, an ultraviolet radiation sensitive photoinitiator is present in a one component composition in an amount of no more than 10 wt-%, even more preferably, no more than 9 wt-%, even more preferably, no more than 8 wt-%, even more preferably, no more than 7 wt-%, even more preferably, no more than 6 wt-%, even more preferably, no more than 5 wt-% and even more preferably, no more than 4 wt-%.

In a two component composition, the ultraviolet radiation sensitive photoinitiator is optional. Preferably, in a two component composition the ultraviolet radiation induced photoinitiator is present in the first part (Component A) of the composition in an amount of at least 1 weight percent (wt-%, based on total weight of solids of the epoxy-modified fatty acid ester resin and ultraviolet radiation sensitive photoinitiator), more preferably, at least 2 wt-%, even more preferably, at least 3 wt-% and even more preferably, at least 4 wt-%.

In a three component composition, the ultraviolet radiation sensitive photoinitiator is optional. Preferably, in a three component composition the ultraviolet...
radiation sensitive photoinitiator is present in the first part (Component A) of the composition in an amount of at least 1 weight percent (wt-%, based on total weight of solids of the epoxy-modified fatty acid ester resin and ultraviolet radiation induced photoinitiator), more preferably, at least 2 wt-%, even more preferably, at least 3 wt-% and even more preferably, at least 4 wt-%.

Suitable ultraviolet radiation sensitive photoinitiators include cationic sulfonium and iodonium salts such as bis (dodecylphenyl) iodonium hexafluoroantimonate, triarylsulfoniumhexafluorophosphate, bis triphenyl sulfonium hexafluorophosphate and 4,4'-dimethyl-diphenyl iodonium hexafluorophosphate. Preferably, the ultraviolet radiation sensitive photoinitiator is a sulfonium salt. Examples of suitable sulfonium salts are those sold in trade as Omnicat 432™ (IGM Resins, Bartlett IL) and Omnicat 440™ (IGM Resins, Bartlett IL).

In certain embodiments of the composition, particularly for outdoor applications, the composition may be cured by exposure to natural sunlight. In other embodiments of the composition, particularly for indoor applications, the composition may be cured by exposure to ultraviolet light. The photoinitiator chosen will determine the wavelength of the ultraviolet light necessary to cure the composition. For example, bis triphenyl sulfonium hexafluorophosphate dissolved 50/50 by weight in propylene carbonate is sensitive to ultraviolet light in the range of 220 - 380 nm with a peak of 251 nm.

The curing agent is preferably an anhydride which is present in the overall composition to dry and cure the epoxy.

In a one component composition the anhydride curing agent is preferably present in 1 weight percent (wt-%, based on total weight of solids of the epoxy-modified fatty acid ester resin, ultraviolet radiation sensitive photoinitiator, and the curing agent in the overall composition), more preferably, at least 2 wt-%, even more preferably, at least 3 wt-%, even more preferably, at least 4 wt-%, even more preferably, at least 4 wt-%, and even more preferably, at least 5 wt-%. Preferably, an anhydride curing agent is present in a one component composition in an amount of no more than 9 wt-%, even more preferably, no more than 8 wt-%, even more preferably,
no more than 7 wt-%, even more preferably, no more than 6 wt-%, and even more preferably, no more than 5 wt-%.

In a two component composition the anhydride curing agent is preferably present in the second part (Component B) of the composition in an amount of at least 55 weight percent (wt-%, based on total weight of solids of the curing agent and catalyst in Component B), more preferably, at least 60 wt-%, and even more preferably, at least 65 wt-%. Preferably, an anhydride curing agent is present in the second part (Component B) of a two component composition in an amount of no more than 85 wt-%, even more preferably, no more than 80 wt-%, even more preferably, no more than 75 wt-%, even more preferably, no more than 70 wt-% and even more preferably, no more than 65 wt-%

in a three component composition the anhydride curing agent is present in the second part (Component B) of the composition in an amount of at least 55 weight percent (wt-%, based on total weight of solids of the curing agent and catalyst in Component B), more preferably, at least 60 wt-% and even more preferably, at least 65 wt-%. Preferably, an anhydride curing agent is present in the second part (Component B) of a two component composition in an amount of no more than 85 wt-%, even more preferably, no more than 70 wt-%, even more preferably, no more than 75 wt-%, even more preferably, no more than 70 wt-% and even more preferably, no more than 65 wt-%.

Suitable anhydride curing agents include methyl tetrahydrophtallic anhydride sold in trade as MTHPA-C™ (Broadview Technologies, Newark NJ) and pyromellitic anhydride sold in trade as PMDA™ (Alfa Aesar, Wardhili MA) or a combination of anhydride curing agents.

A catalyst is preferably present in the second part (Component B) of the two and three component compositions to speed polymerization.

In a two component composition the catalyst is preferably present in the second part (Component B) of the composition in an amount of at least 15 weight percent (wt-%, based on total weight of solids of the curing agent and catalyst in Component B), more preferably, at least 20 wt-%, even more preferably, at least 25
wt-%, even more preferably, at least 30 wt-% and even more preferably, at least 35 wt-%. Preferably, a catalyst is present in the second part (Component B) of a two component composition in an amount of no more than 45 wt-%, even more preferably, no more than 40 wt-% and even more preferably, no more than 35 wt-%.

In a three component composition the catalyst is present in the second part (Component B) of the composition in an amount of at least 15 weight percent (wt-%, based on total weight of solids of the curing agent and catalyst in Component B), more preferably, at least 20 wt-%, even more preferably, at least 25 wt-%, even more preferably, at least 30 wt-% and even more preferably, at least 35 wt-%. Preferably, a catalyst is present in the second part (Component B) of a two component composition in an amount of no more than 45 wt-%, even more preferably, no more than 40 wt-% and even more preferably, no more than 35 wt-%.

Suitable catalysts include (Z)-2-butenedioic acid or toxilic acid or maleinic acid or maleinic acid, or cis-1,2-ethylenedicarboxylic acid commonly known as maleic acid sold in trade as MS (Aifa Aesar, Wardhill MA).

A filler or inert ingredient is preferably present in the third part (Component C) of the three component composition. Fillers or inert ingredients modify the appearance of and/or provide characteristics such as increased flexibility or durability after curing as well as increasing the volume of the final composition. Fillers or inert ingredients include, for example, calcium phosphate, shredded recycled rubber, ground rubber in both round cold milled form and fine flake, clay, glass beads, calcium carbonate, talc, silica and the like or combinations thereof.

Other suitable fillers are known to those skilled in the art or can be determined using standard methods and can be chosen to suit the particular application of composition.

Preferably, the filler or inert ingredient can make up at least 1% by weight of the total weight of a three component embodiment of the composition. Preferably, the filler or inert ingredient can make up no more than 90% by weight of the total weight of a three component embodiment of the composition.
if the composition is intended as a coating, addition of pigments, extender pigments dispersing agents, defoamers and the like may be desirable. Such pigments, extender pigments, dispersing agents and defoamers are known to those skilled in the art. For example, pigments may include titanium dioxide, carbon black etc. Preferably, such pigments, extender pigments, dispersing agents, defoamers and the like can make up at least 0.001% by weight of the total weight of a composition of the present invention. Preferably, such pigments extender pigments, dispersing agents, defoamers and the like can make up no more than 95% by weight of the total weight of a composition of the present invention. Preferably, such pigments extender pigments, dispersing agents, defoamers and the like are combined with the first part (i.e. Component A) of a two component or three component composition.

Test Methods

Oxirane values are analyzed using the Official and Recommended Practices of the American Oil Chemists' Society (1997).

Iodine values are represented as g 2/100 ml oil as per American Oil Chemists' Society Method AOCS Tg2a-64.

EXAMPLES

Example 1: Example of a one component composition

Preparation of an Anti-Graffiti Coating

98 grams of epoxidized high alpha linolenic acid linseed oil (known in trade as epoxidized HIOMEGA linseed oil), 4 grams of bis triphenyl sulfonium hexafluorophosphate (known in trade as Omnicat 432) and 5 grams of methyl tetrahydrophthalic anhydride (known in trade as MTHPA) are thoroughly mixed by stirring. The mixture is gently stirred for 2 minutes so as not to introduce air pockets. The fluid mixture can be applied directly to concrete, wood, metal, plastic or any similar clean dry surface and is useful as a surface protectant or anti-graffiti coating. The anti-graffiti coating can be applied directly with a paint roller, brush, sponge or
similar instrument. The mixture can be thinned 50:50 with common solvents such as denatured alcohol and sprayed directly onto such surfaces using a high volume low pressure (HVLP) spray applicator. The coating will cure in natural sunlight within 5 minutes and harden completely within 15 minutes. The coating may also be cured with ultraviolet lights for indoor applications. The wavelength of the ultraviolet light with a wavelength of 220 - 380 nm with a peak of 251 nm. This mixture is particularly useful as an antigraffiti coating since the coating cures to a hard and clear surface, protecting the substrate from graffiti. Once a surface is treated with this no-voc anti-graffiti coating, graffiti or tagging can be easily wiped off or washed away with a pressure washer using water or denatured alcohol. The mixture may be stored in an air tight, light proof container for 2 years. The advantages of this one component coating are the qualities of no-voc, fast cure time and the use of renewable vegetable based natural oil epoxies which combined form a hard, clear, and resistant coating.

Example 2: Example of a two component composition

No-VOC Epoxy Glue for Metal, Wood, Paper, Linoleum, Concrete or Fiberglass

The first part of the composition (Component A) is mixed by stirring together 96 grams of epoxidized high alpha linolenic acid linseed oil (known in trade as epoxidized HIOMEGA linseed oil) and 4 grams of bis triphenyl sulfonium hexafluorophosphate (known in trade as Omnicat 432). Component A may be stored in an air tight, light proof container for up to 2 years. Prior to use Component A should be stirred thoroughly yet gently for 2 minutes so as to mix the composition but not to introduce air pockets. The second part of the composition (Component B) or hardener is mixed by stirring together 40 grams of methyl tetrahydrophthalic anhydride (known in trade as MTHPA), 40 grams of pyromellitic anhydride (known in trade as PMDA) and 20 grams of maleic acid. Component B may be stored in an air tight container for up to 6 months. Prior to use Component A should be stirred thoroughly yet gently for 2 minutes so as to mix the composition but not to introduce air pockets. To make the total composition, mix by stirring Component A and Component B together in a 1.65 : 1 ratio by weight. For example 82.5 grams of Component A and 50 grams of
Component B are stirred together for 2 minutes. To use, apply the total composition (Component A + Component B) to both sides of the metal, wood, paper, linoleum or concrete surfaces which will be glued together. The total composition may be applied with a brush, roller, sponge or similar instrument. Expose surfaces to natural sunlight or ultraviolet light for several minutes (2-3 minutes) to initiate drying. Press surfaces firmly together and let dry. A strong bond will form between surfaces as epoxy dries.

For application of the total composition to fiberglass, layer fiberglass sheets with epoxy glue. For example, lay flat one fiberglass sheet. Apply no-VOC epoxy glue with a roller to entire sheet. Layer another fiberglass sheet on top and smooth over with roller to remove possible air bubbles. Continue layering glue and fiberglass sheets until desired thickness is achieved. Expose to natural sunlight or ultraviolet radiation for several minutes (2-10 minutes) to cure. A strong, durable fiberglass sheet is created.

The advantages of this two component composition are the qualities of no-voc, fast cure time and the use of renewable vegetable based natural oil epoxies which combined form a strong, durable and resistant bond.

Example 3: Example of a three component composition

No-VOC Rubber Floor Coating

The first part of the composition (Component A) is mixed by stirring together 96 grams of epoxidized high alpha linolenic acid linseed oil (known in trade as epoxidized HIOMEGA linseed oil) and 4 grams of bis triphenyl sulfonium hexafluorophosphatate (known in trade as Omnicat 432). Component A may be stored in an air tight, light proof container for up to 2 years. Prior to use Component A should be stirred thoroughly yet gently for 2 minutes so as to mix the composition but not to introduce air pockets. The second part of the composition (Component B) or hardener is mixed by stirring together 40 grams of methyl tetrahydrophthalic anhydride (known in trade as MTHPA), 40 grams of pyromellitic anhydride (known in trade as PMDA) and 20 grams of maleic acid. Component B may be stored in an air tight container for up to 6 months. Prior to use Component A should be stirred thoroughly yet gently for 2
minutes so as to mix the composition but not to introduce air pockets. The third part of the composition (Component C) is shredded recycled rubber. To make the total composition, mix by stirring Component A and Component B together in a 1.65 : 1 ratio by weight. For example 82.5 grams of Component A and 50 grams of Component B are stirred together for 2 minutes. Component C is added to the Component A + Component B mixture in a 5:1 ratio by weight. For example, 50 grams of rubber (Component C) is mixed with 10 grams of the Component A + Component B mixture. The total composition makes a rubber floor coating which may be applied by spreading onto a wood or concrete surface. Exposure to natural sunlight or ultraviolet radiation will cure the floor coating to a hard, durable surface within several minutes.

While the preferred embodiments of the invention have been described above, it will be recognized and understood that various modifications may be made therein, and the appended claims are intended to cover all such modifications which may fail within the spirit and scope of the invention.
CLAIMS

1. A composition for coatings, adhesives, sealants and elastomers comprising an epoxy-modified fatty acid resin, a catalyst and a curing agent.

2. The composition according to claim 1 wherein the epoxy-modified fatty acid resin is an epoxidized natural vegetable oil selected from the group consisting of epoxidized high alpha linolenic acid linseed oil, epoxidized low alpha linolenic acid linseed oil, epoxidized soybean oil and combinations thereof.

3. The composition according to claim 1 wherein the epoxy-modified fatty acid resin is an epoxidized high alpha linolenic acid linseed oil.

4. The composition according to claim 1 wherein the composition comprises 91-99% epoxy-modified fatty acid resin, 0.5-8.5% catalyst and 0.5-8.5% curing agent.

5. The composition according to claim 1 wherein the catalyst is an ultraviolet radiation induced photoinitiator.

6. The composition according to claim 5 wherein the ultraviolet radiation induced photoinitiator is an onium salt cationic photoinitiator.

7. The composition according to claim 5 wherein the ultraviolet radiation induced photoinitiator is selected from the group consisting of bis (dodecylphenyl) iodonium hexafluoroantimonate, triarylsulfoniumhexafluorophosphate, bis triphenyl sulfonium hexafluorophosphate and 4,4’-dimethyl-diphenyl iodonium hexafluorophosphate or combinations thereof.

8. The composition according to claim 1 comprising;
   a first component comprising 96-100% epoxy-modified fatty acid resin and 0-4% UV radiation induced photoinitiator; and
   a second component comprising 55-85% curing agent and 15-45% catalyst.

9. The composition according to claim 9 wherein the composition includes a third component comprising a filler or an inert material.

10. The composition according to claim 1 wherein the curing agent is at least one anhydride.
11. The composition according to claim 10 wherein the at least one anhydride is selected from the group consisting of methyl tetrahydrophthalic anhydride, pyromellitic anhydride and combinations thereof.

12. The composition according to claim 1 wherein the catalyst is a dibasic acid.

13. The composition according to claim 1 wherein the catalyst is maleic acid.

14. The composition according to claim 9 wherein the filler or inert material is selected from the group consisting of calcium phosphate, shredded recycled rubber, ground rubber in both round cold milled form and fine flake, clay, glass beads, calcium carbonate, talc, silica and the like and combinations thereof.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC: C08G 59/32 (2006.01), C08G 59/42 (2006.01), C08G 59/68 (2006.01), C09D 163/00 (2006.01), C09J 163/00 (2006.01)
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)
COSG 59/32 (2006.01), COSG 59/42 (2006.01), COSG 59/68 (2006.01), COSG 163/00 (2006.01)
COSG 163/00 (2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
CAS Registry, CAPlus database, Intellect, West, Delphion (epoxy-modified, fatty acid resin, catalyst, curing agent, linseed oil, epoxidiz(s)ed, soybean oil)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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Further documents are listed in the continuation of Box C.

[X] See patent family annex.

Date of the actual completion of the international search
12 May 2009 (12-05-2009)

Date of mailing of the international search report
21 July 2009 (21-07-2009)

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Authorized officer
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