TWO-PART LIGHTWEIGHT AND LOW HEAVY METAL CONTENT EPOXY NON-SKID COATING FOR A DECK OR FLOOR

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of pending U.S. Provisional Patent Application No. 60/883,535 entitled "Two-Part Epoxy Non-Skid Coating for a Deck or Floor" filed on January 5, 2007, which is hereby incorporated by reference herein.

BACKGROUND OF THE INVENTION

[0002] This invention relates generally to non-skid coatings, and more specifically to lightweight, low abrasive and low heavy metal content non-skid coatings suitable for floors and decks.

[0003] Non-skid coatings for ship decks should be durable, environmentally friendly and light-weight while still having sufficient anti-slippage properties. For naval ships, particularly aircraft carriers, multiple non-skid coatings may be used. For example, an aircraft carrier may use an "L Composition" non-skid coatings in the landing areas of flight decks and a general non-skid "G Composition" for all other areas. The landing area deck coatings must have non-abrasive aggregate in order to avoid abrading the arresting cables. Typically, flight deck coatings comprise a two-part reactive resin (including, but not limited to, epoxy resins), fillers, additives, thixotropes, etc. with an aluminum granule/aggregate filler. However, the current coatings still are heavier than desired, contain high amounts of specific heavy metals and do not provide enhanced anti-slip properties.

BRIEF SUMMARY OF THE INVENTION

[0004] In one embodiment, the invention is a composition for non-skid coatings, the composition comprising a two-part reactive resin (including, but not limited to, epoxy resins), fillers, additives, thixotropes, etc. and an aggregate/granule filler comprising particles of a thermoset and/or thermoplastic resin. In other embodiments, the thermoset resin is a special type of polycarbonate resin. Generally, the inventive composition is characterized

by having lower heavy metal content than a composition having a similar loading of a filler comprising aluminum based particles and in having a density that is about 15 to about 30 percent less than a composition having a similar loading of a filler comprising aluminum or aluminum oxide based particles.

DETAILED DESCRIPTION OF THE INVENTION

[0005] The epoxy resin (other thermoset two part reactive resins can also be used in whole or to modify the epoxy) used in the practice of this invention may vary and includes conventional, commercially available epoxy resins. Two or more epoxy resins may be employed in combination. In general, known epoxy resins that are currently used for navy ship deck applications can be used. As described in USP 7,037,958, incorporated herein by reference, such epoxy resins can be glycidated resins, cycloaliphhatic resins, epoxidized oils, and so forth. The glycidated resins are frequently the reaction product of a glycidyl ether, such as epichlorohydrin, and a bisphenol compound such as bisphenol A; C_4-$C_{.28}$ alkyl glycidyl ethers; C_2-$C_{.28}$ alkyl-and alkenyl-glycidyl esters; C_1-$C_{.28}$ alkyl-, mono- and poly-phenol glycidyl ethers; polyglycidyl ethers of pyrocatechol, resorcinol, hydroquinone, 4,4'-dihydroxydiphenyl methane (or bisphenol F or Novalac), 4,4'-dihydroxy-3,3'-dimethyldiphenyl methane, 4,4'-dihydroxydiphenyl dimethyl methane (or bisphenol A), 4,4'-dihydroxydiphenyl methyl methane, 4,4'-dihydroxydiphenyl cyclohexane, 4,4'-dihydroxy-3,3'-dimethyldiphenyl propane, 4,4'-dihydroxydiphenyl suflone, and tris (4-hydroxyphynyl)methane; polyglycidyl ethers of the chlorination and bromination products of the above-mentioned diphenols; polyglycidyl ethers of novolacs; polyglycidyl ethers of diphenols obtained by esterifying ethers of diphenols obtained by esterifying salts of an aromatic hydrocarboxylic acid with a dihaloalkane or dihalogen dialkyl ether; polyglycidyl ethers of polyphenols obtained by condensing phenols and long-chain halogen paraffins containing at least two halogen atoms; N,N'-diglycidyl-aniline; N,N'-dimethyl-N,N'-diglycidyl-4,4'-diaminodiphenyl methane; N,N,N',N'-tetraglycidyl-4,4'-diaminodiphenyl methane; N,N'-diglycidyl-4-aminophenyl glycidyl ether; N,N,N',N'-tetraglycidyl-1,3-propylene bis-4-aminobenzoate; phenol novolac epoxy resin; cresol novolac epoxy resin; and combinations thereof. Representative non-limiting examples of epoxy resins useful in this

invention include bis-4,4'-(1-methylethylidene) phenol diglycidyl ether and (chloromethyl) oxirane Bisphenol A diglycidyl ether. Commercially available epoxy resins that can be used in the practice of this invention include, but are not limited to, Araldite GY6010, DER 331, Epalloy 1500, Epalloy 1501, GZ7071PM75 and Epon 828. Generally any conventional epoxy resin or hydrogenated epoxy resin with an epoxide equivalent weight of between 100 and 750 eew.

[0006] The non-skid coating is made by incorporating aggregate material into the epoxy coating. The aggregates usable for this invention can comprise thermoset and/or thermoplastic polymer resins used alone, blended or in combination with other low abrasive aggregates. Such resins include, but are not limited to, polycarbonates, such as allyl diglycol carbonate, ABS, methylmethacrylate as well cured epoxies, polyurethanes, acrylics, polyesters, and the like. The aggregate material is ground, milled or crushed to the desired particle size for a particular end use. A particularly convenient source for the thermoset polycarbonate aggregate material is crushed lenses from used eyeglasses. Typical particles sizes are in the 150 micron to 1600 micron range and can incorporate any ratio or blend of these particles sizes to optimize application and coefficient of friction characteristics.

[0007] Additionally, the aggregate can comprise plant-based aggregates. Such plant-based aggregates can be, for example, ground up nut shells, including, but not limited to, walnuts, Korean pine nuts, coconuts, etc. The plant-based aggregates can comprise up to 100% plant-based material or may be combined with aggregates/granules made from silica-free geological materials. Preferably the geological minerals have a Moh's hardness value from about 3 to about 7. Suitable examples of geological minerals include, but are not limited to, nephaline syenite and amorphous glass silicates.

[0008] The polymer aggregate can be used as 100% of the aggregate or may be partially or totally replaced with plant-based aggregate. As such, the aggregate comprises between 0-100% polymer aggregate and 0-100% plant-based aggregate, with the percentage of the polymer aggregate and the plant based aggregate summing to 100%.

[0009] The aggregate can be mixed into either, the resin or hardener or both, of the two epoxy components prior to blending the components together to begin the epoxy cure.

[00010] Numerous benefits can be achieved by using the inventive non-skid coating in place of existing non-skid coatings. First, the coatings weigh 15 to 30 % less, on an equal volume basis, than current G or L compositions using aluminum or aluminum oxides. Second, the inventive coatings contain significantly reduced levels of heavy metal contamination. This benefit is particularly important due to the ever more restrictive EPA guidelines when the non-skids are removed from the decks and disposed in landfills. These metals include, but are not limited to, the following examples of reduced total metals content over the prior art.

	Typical Alumiinum Containing Non-Skid Total Metals Content	**Typical Polymer Containing Non-Skid Total Metals Content**
Chromium VI	0.0005%	0.00013%
Antimony	0.006%	0.000047%
Arsenic	0.0087%	0.00024%
Beryllium	0.00188%	0.000021%
Cadmium	0.00095%	ND%
Chromium and/or Chromium III	<0.005%	ND%
Cobalt	<0.001%	0.00044%
Copper	0.0182%	0.0048%
Lead	0.015%	0.00006%
Molybdenum	0.0033%	0.000033%
Mercury	<0.0001%	<0.0001%
Nickel	0.0365%	0.00015%
Selenium	<0.001%	ND%
Silver	0.01%	ND%
Thallium	<0.001%	ND%
Zinc	0.0052%	0.00026%

[00011] Third, the anti-slip properties of the inventive coatings are better because the aggregate particles tend to be angular compared to the generally smooth or spherical particles of aluminum aggregates. Typical improvements in anti-slip coefficient of friction properties are measured using the guidelines of MIL-PRF-24667B for 50 cycles and 500 cycles of the arresting cable are:

	Typical Aluminum Non skid		Typical Polymer Grit Non-Skid	
	50 Cycles	500 cycles	50 Cycles	500 Cycles
DRY	1.03	0.95	1.20	1.80
WET	0.96	0.92	1.20	1.50
OILY	0.93	0.86	1.10	1.20

[00012] The inventive coatings have been blind tested on carrier fight decks. These tests demonstrated that the inventive coatings have sufficient durability and anti-slip properties, while also being sufficiently nonabrasive to the arresting cables to comply with the requirements for such applications.

[00013] The inventive coatings can be used in any situation where non-skid decks and flooring are required and low-coating weight is desired. Examples include floors in wet environments such as decks and steps on water-going vessels including boats, barges and ships, aircraft carrier flight decks, etc.

[00014] In compliance with the statute, the invention has been described in language more or less specific as to structural and methodical features. It is to be understood, however, that the invention is not limited to the specific features shown and described, since the means herein disclosed comprise preferred forms of putting the invention into effect. The invention is, therefore, claimed in any of its forms or modifications within the proper scope of the appended claims appropriately interpreted in accordance with the doctrine of equivalents.

WHAT IS CLAIMED IS:

1. A composite for non-skid coatings, comprising a two-part epoxy, and an aggregate filler comprising ground, milled or crushed particles of polycarbonate having particle sizes in the range 150 μm to 1600 μm, ground up nut shells and aggregates of geological minerals having Moh's hardness in the range 3 to 7.

2. The composition of claim 1, wherein the geological mineral comprises nepheline syenite.

3. A non-slip deck or floor comprising:

a substantially horizontal flooring surface; and

a non-skid coating that at least partially covers the flooring surface, wherein the coating comprises a cured composition according to any of the preceding claims.

4. The deck or floor of claim 3, wherein the flooring surface is the deck of a water-going vessel.

5. The deck or floor of claim 4, wherein the vessel is an aircraft carrier.

6. The deck or floor of claim 5, wherein the flooring surface is a flight deck.