

provide an epoxy resin composition of the above-mentioned type which shows good storage stability (long pot life) and which does not form a long tail when applied at a high speed by means of a dispenser.

5 In accomplishing the foregoing object, there is provided in accordance with the present invention a liquid epoxy resin composition comprising ^{... New cl. 1} ~~a liquid epoxy resin, an amine curing agent, an inorganic filler, and an organic rheology additive.~~

Brief Description of the Drawings

Other objects, features and advantages of the present invention will become apparent from the detailed description of the preferred embodiments which follow, when
15 considered in light of the accompanying drawings, in which:

Fig. 1(a) is a vertical sectional view showing a shape of a dot of an epoxy resin composition applied to a surface of a board with a dispenser; and

Fig. 1(b) is a plan view of Fig. 1(a).

Detailed Description of the Preferred Embodiments of the Invention

The liquid, epoxy resin composition according to the present invention contains an epoxy resin, a curing agent, an inorganic filler and an organic rheology additive.
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The epoxy resin is a liquid epoxy resin having two or more epoxy groups in its molecule. Examples of suitable epoxy resins include diglycidyl ethers of bisphenol A, bisphenol F, bisphenol AD, brominated bisphenol A, phenol novolak resins, glycerin and polyalkylene oxides; glycidyl esters of carboxylic acids such as dimer acid and isophthalic acid; epoxidized polybutadiene obtained by reaction of polybutadiene with peracetic acid; urethane-modified diglycidyl ethers of bisphenol A; heterocyclic epoxy resins; and mixtures thereof. These epoxy resins may be used singly
30 or as a mixture of two or more. The use of epoxy resins which are liquid at room temperature is preferred. But, it
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is possible to use crystalline or solid epoxy resins if they are able to be dissolved in the liquid epoxy resin used.

As the amine curing agent, conventional latent curing agents having two or more primary, secondary or

5 tertially amine groups, such as dicyandiamide, derivatives of dicyandiamide, imidazole compounds, organic acid hydrazides, amine-adducts, spiroacetal compounds, modified polyamides, modified polyamines and amine-urea adducts are suitably used.

Illustrative of suitable imidazole compounds are 2-

10 heptadecylimidazole, 2-phenyl-4,5-dihydroxymethylimidazole, 2-phenyl-4-methyl-5-hydroxymethylimidazole, 2-phenyl-4-benzyl-5-hydroxymethylimidazole, 2,4-diamino-6-(2-methylimidazolyl-(1))ethyl-5-triazine and an addition product of the triazine with isocyanuric acid. Illustrative of

15 suitable hydrazides are succinohydrazide, adipohydrazide, isophthalohydrazide, o-oxybenzohydrazide and salicylohydrazide. Examples of amine adducts include AMICURE PN-23 (manufactured by Ajinomoto Co., Inc.), AMICURE MY-24 (manufactured by Ajinomoto Co., Inc.) and NOVACURE HX-3721

20 (manufactured by Asahi Kasei Kogyo K. K.). Examples of spiroacetal compounds include AMICURE ATU CARBAMATE 3 (manufactured by Ajinomoto Co., Inc.). Examples of modified polyamides include Hardner HT939 (manufactured by Japan Ciba Geigy Inc.), examples of modified polyamines include Hardner

25 H4070S (manufactured by ACR Japan Inc.) and examples of amine-urea adducts include Fujicure FXE-1000 (manufactured by Fuji Kasei K. K.). The amine curing agent is generally used in an amount of 3-60 parts by weight, preferably 5-40 parts by weight per 100 parts by weight of the epoxy resin.

30 ~~Any known organic rheology additive may be used for the purpose of the present invention.~~ Illustrative of ~~suitable rheology additives are~~ modified castor oil rheology additives and organic amide rheology additives. ^{are used in the present invention} The modified castor oil additive having a melting point of 60-140°C is

35 ^{preferably} suitably used. The modified castor oil additive is a product obtained by hydrogenating castor oil and may be, for example, Thixcin-R manufactured by Rheox Intern. Inc. The modified

amide rheology additives are products which are obtained by reacting a polycarboxylic acid, such as cebasic acid, dodecane dicarboxylic acid or dimer acid, with an active hydrogen-containing compound, such as 1,6-diaminohexane, 1,8-diaminooctane or 1,6-hexanediol, using, as a capping agent, a hydroxycarboxylic acid, such as ricinoleic acid or 12-hydroxystearic acid and which are disclosed in Japanese Published Unexamined Patent Application No. 63-145332. The rheology additive is generally used in an amount of 0.1-15 parts by weight, preferably 1-10 parts by weight per 100 parts by weight of the epoxy resin.

~~Any inorganic filler may be used for the purpose of the present invention. Illustrative of suitable inorganic fillers are silica, calcium carbonate, dolomite, calcium silicate, alumina, mica, talc and clay. The inorganic filler generally has an average particle diameter of 0.5-20 μ m, preferably 1-10 μ m. It is preferred that~~ Calcined talc be used as the inorganic filler for reasons of improved pot life and storage stability. The calcined talc is a product obtained by heating talc at a temperature sufficient to effect the dehydration thereof, preferably at 900-1,200°C. The inorganic filler is generally used in an amount of 1-100 parts by weight, preferably 5-50 parts by weight per 100 parts by weight of the epoxy resin.

The liquid epoxy resin composition of the present invention may further contain various conventional additives such as a reactive diluent, a pigment, an antifoaming agent and a leveling agent. The reactive diluent is a compound which has at least one epoxy group and which is a low viscosity liquid at room temperature. Examples of suitable reactive diluents include phenyl glycidyl ether, polyethylene glycol diglycidyl ether, polypropylene glycol diglycidyl ether, methyl glycidyl ether, propyl glycidyl ether, pentaerythritol polyglycidyl ether, sorbitan polyglycidyl ether, n-butyl glycol glycidyl ether and 2-ethylhexyl glycidyl ether. The reactive diluent is used for decreasing the viscosity of the composition.

- B-2: Modified polyamide curing agent, Hardner HT939, manufactured by Ciba Geigy Inc.
- B-3: Modified aliphatic polyamine curing agent, ACR Hardner H-4070S, manufactured by ACR Inc.

Rheology Additive: Castor oil rheology additive, Thixcin-R, manufactured by Rheox Intern. Inc., melting point: 86°C

Inorganic Filler

- D-1: Hydrophilic silica, Aerosil #300, manufactured by Nippon Aerosil Inc.
- D-2: Hydrophobic silica, Aerosil R202, manufactured by Nippon Aerosil Inc., silicone oil-treated silica
- D-3: ^{Calcined talc} ~~Sintered silica~~, Enstac 24, manufactured by Asada Seifun K. K., average particle size: 3.0 μ m, talc sintered at 1,100°C
- D-4: Talc, LMP-100, manufactured by Fuji Talc Industry Co., Ltd., average particle size: 3.0 μ m
- D-5: Silica, Imsil A108, manufactured by Tatsumori Inc.

Each of the epoxy resin compositions Nos. 1-12 thus obtained was measured for the R-value, adaptability to high speed dispensation and pot life in the manner described below. The results are shown in Table 1.

R Value:

Using a cone plate rotational viscometer (EHD Rotational Viscometer manufactured by Tokimec Inc., cone diameter: 28 mm, cone angle: 3 degree), a relationship between the rate of shear D (sec^{-1}) and the shearing stress S (Pa) of a sample composition is measured at 25°C at rotational speeds of the cone plate of 0.5, 1.0, 2.5, 5.0 and 10 rpm after 5 minutes from the commencement of the rotation. In the case of the above viscometer, the rates of shear D at

WHAT IS CLAIMED IS:

1. A liquid epoxy resin composition comprising a liquid epoxy resin, an amine curing agent, ^{calcined talc}~~an inorganic filler~~, and an organic rheology additive.

2. A composition according to claim 1 and having an R-value of not greater than 0.4, wherein R-value is defined by the following equation:

$$R = \eta_{10}/Sc$$

wherein η_{10} is a viscosity of the composition at a rate of shear of 10 sec^{-1} and Sc represents a Casson yielding point determined according to the following equation:

$$S^{1/2} = (Sc)^{1/2} + (\mu_c \times D)^{1/2}$$

wherein S represents a shearing stress of the composition, Sc is as defined above, D is a rate of shear of the composition and μ_c represents a Casson viscosity of the composition.

~~3. A composition according to claim 1, wherein said rheology additive is selected from modified castor oil additives and organic amide rheology additives.~~

~~3A.~~ A composition according to claim 1, wherein said modified castor oil additive has a melting point of 60-140°C.

~~4B.~~ A composition according to claim 1, wherein the inorganic filler has an average particle diameter of 0.5-20 μm .

~~6. A composition according to claim 1, wherein said inorganic filler is calcined talc.~~