that a single coat of the new solvent free epoxy is superior to two coats of existing universal primer coatings when compared at the same total DFT (320 micrometer).

Overcoating intervals is another common challenge with solvent free systems, as the maximum overcoating interval tends to be rather short. The current formulations offer recoating intervals up to 2 weeks under outdoor exposure. This is the same level as existing solvent born products and considered to be good for a solvent free system.

Another target of this development has been to develop a product that can be applied all year around with conventional airless spray equipment and with a good pot life. In order to reach this goal much efforts has been spend on decreasing viscosity whilst maintaining anticorrosive properties, a task that has been successfully completed at least for a temperature interval in the range between -5 and 40 ℃.

In addition it has been found that the current solvent free epoxy coating compositions offers excellent anticorrosive properties, long pot life and good drying time. In contrast, most solvent free systems show significantly increased drying times and a short pot-life.

Summary

Thus, the disclosure provides an ultra-high solids content primer coating composition comprising:

(i) 5.0 to 50 wt% of at least one bisphenol F epoxy resin;

(ii) 1.5 to 12 wt% of at least one silane;

(iii) 0.5 to 20 wt% of at least one hydrocarbon resin;

(iv) 1.0 to 15 wt% at least one reactive diluent; and

(v) at least one curing agent;

wherein said composition has a solids content of at least 90 wt% measured according to ASTM D5201-05;

wherein said composition has a viscosity of 200 to 800 cps at 23°C and 50% RH (ASTM D4287); and

wherein the ratio between active hydrogen equivalents in the curing agent and epoxy equivalents of the coating composition is in the range 50:100 to 120:100.

Preferably, the coating composition has a solvent content of less than 5 wt%.

The disclosure also provides an ultra-high solids content primer coating composition comprising:

(i) 5.0 to 50 wt% of at least one bisphenol F epoxy resin;

(ii) 1.5 to 12 wt% of at least one silane;

(iii) 0.5 to 20 wt% of at least one hydrocarbon resin;

(iv) 0 to 15 wt% at least one reactive diluent; and

(v) at least one curing agent;

wherein said composition has a solids content of at least 90 wt% measured according to ASTM D5201-05;

wherein said composition has a viscosity of 200 to 800 cps at 23°C and 50% RH; and

wherein the ratio between active hydrogen equivalents in the curing agent and epoxy equivalents of the coating composition is in the range 50:100 to 120:100.

The disclosure also provides an ultra-high solids content primer coating composition comprising:

(i) 5.0 to 50 wt% of at least one bisphenol F epoxy resin;

(ii) 1.5 to 12 wt% of at least one silane;

(iii) 0 to 20 wt% of at least one hydrocarbon resin;

(iv) 1.0 to 15 wt% at least one reactive diluent; and

(v) at least one curing agent;

wherein said composition has a solids content of at least 90 wt% measured according to ASTM D5201-05;

wherein said composition has a viscosity of 200 to 800 cps at 23°C and 50% RH (ASTM D4287); and

wherein the ratio between active hydrogen equivalents in the curing agent and epoxy equivalents of the coating composition is in the range 50:100 to 120:100.

Viewed from one aspect the disclosure provides an ultra-high solids content primer coating composition comprising:

(i) 5.0 to 50 wt% of at least one bisphenol F epoxy resin;

(ii) 1.5 to 12 wt% of at least one silane;

(iii) 0 to 20 wt% of at least one hydrocarbon resin;

(iv) 1.0 to 15 wt% at least one reactive diluent; and

(v) at least one curing agent;

wherein said composition has a solids content of at least 90 wt% measured according to ASTM D5201-05;

wherein said composition has a viscosity of 200 to 800 cps at 23°C and 50% RH (ASTM D4287);

wherein the ratio between active hydrogen equivalents in the curing agent and epoxy equivalents of the coating composition is in the range 50:100 to 120:100; and wherein said silane is tris(3-trimethoxysilylpropyl) isocyanurate or is of general formula (I) or (II)

$$Y\text{-}R_{(4-z)}SiX_z \quad (I) \quad \text{or}$$

$$Y\text{-}R_{(3-y)}R^1SiX_y \quad (II)$$

wherein z is an integer from 1 to 3,

wherein y is an integer from 1 to 2,

R is a hydrocarbyl group having 1 to 12 C atoms or a hydrocarbyl group having 1 to 12 C atoms containing an ether or amino linker,

R^1 is a hydrocarbyl group having 1 to 12 C atoms;

Y is a functional group bound to R that can react with corresponding curing agent or epoxy resin functionalities and

each X independently represents a halogen group or an alkoxy group.

The disclosure also provides an ultra-high solids content primer coating composition comprising:

(i) 5.0 to 50 wt% of at least one bisphenol F epoxy resin;

(ii) 1.5 to 12 wt% of at least one silane;

(iii) 0 to 20 wt% of at least one hydrocarbon resin;

(iv) 0 to 15 wt% at least one reactive diluent; and

(v) at least one curing agent;

wherein said composition has a solids content of at least 90 wt% measured according to ASTM D5201-05;

wherein said composition has a viscosity of 200 to 800 cps at 23°C and 50% RH (ASTM D4287); and

wherein the ratio between active hydrogen equivalents in the curing agent and epoxy equivalents of the coating composition is in the range 50:100 to 120:100.

The disclosure also provides an ultra-high solids content primer coating composition comprising:

a component (A) comprising at least one bisphenol F epoxy resin; and

a component (B) comprising at least one curing agent;

said primer coating composition further comprising at least one silane, and optionally at least one hydrocarbon resin; and optionally at least one reactive diluent;

wherein said coating composition comprises:

(i) 5.0 to 50 wt% of at least one bisphenol F epoxy resin;

(ii) 1.5 to 12 wt% of at least one silane;

(iii) 0 to 20 wt%, such as 0.5 to 20 wt%, of at least one hydrocarbon resin;

(iv) 0 to 15 wt%, such as 1.0 to 15 wt%, of at least one reactive diluent;

wherein said composition has a solids content of at least 90 wt%;

wherein said composition has a viscosity of 200 to 800 cps at 23°C and 50% RH;

and wherein the ratio between active hydrogen equivalents in the curing agent and epoxy equivalents of the coating composition is in the range 50:100 to 120:100.

The disclosure also provides a kit comprising:

a component (A) comprising at least one bisphenol F epoxy resin; and

a component (B) comprising at least one curing agent;

components (A) and (B) being suitable for blending prior to application of the resulting composition to a substrate:

wherein upon blending components (A) and (B) the resulting composition comprises:

(i) 10 to 50 wt% of at least one bisphenol F epoxy resin;

(ii) 1.5 to 12 wt% of at least one silane;

(iii) 0 to 20 wt%, such as 0.5 to 20 wt%, of at least one hydrocarbon resin;

(iv) 0 to 15 wt%, such as 1.0 to 15 wt%, of at least one reactive diluent;

wherein said composition has a solids content of at least 90 wt%;

wherein said composition has a viscosity of 200 to 800 cps at 23°C and 50% RH;

and wherein the ratio between hydrogen equivalents in the curing agent and epoxy equivalents of the coating composition is in the range 50:100 to 120:100.

Viewed from another aspect the disclosure provides a kit suitable for the preparation of a coating composition as defined in claim 1 comprising a component (A) comprising:

(i) 20 to 60 wt% of at least one bisphenol F epoxy resin;

(ii) 2.0 to 15 wt% at least one silane which is tris(3-trimethoxysilylpropyl) isocyanurate or of general formula (I) or (II)

$$Y\text{-}R_{(4-z)}SiX_z \qquad (I) \qquad \text{or}$$

$$Y\text{-}R_{(3-y)}R^1SiX_y \qquad (II)$$

wherein z is an integer from 1 to 3,

wherein y is an integer from 1 to 2,

R is a hydrocarbyl group having 1 to 12 C atoms or a hydrocarbyl group having 1 to 12 C atoms containing an ether or amino linker,

R^1 is a hydrocarbyl group having 1 to 12 C atoms;

Y is a functional group bound to R that can react with corresponding curing agent or epoxy resin functionalities; and

each X independently represents a halogen group or an alkoxy group;

(iii) 0 to 20 wt% of at least one hydrocarbon resin; and

(iv) 1.0 to 15 wt%, at least one reactive diluent;

and a component (B) comprising at least one curing agent;

wherein, when components (A) and (B) are combined, the resulting coating composition has a solids content of at least 90 wt% measured according to ASTM D5201-05;

wherein said composition has a viscosity of 200 to 800 cps at 23°C and 50% RH (ASTM D4287); and

wherein the ratio between active hydrogen equivalents in the curing agent and epoxy equivalents of the coating composition is in the range 50:100 to 120:100.

The disclosure also provides a kit comprising:

a component (A) comprising:

(i) 20 to 60 wt% of at least one bisphenol F epoxy resin;

(ii) 2.0 to 15 wt% of at least one silane;

(iii) 0.5 to 20 wt% of at least one hydrocarbon resin; and

(iv) 0 to 15 wt%, such as 1.0 to 15 wt%, of at least one reactive diluent;

and a component (B) comprising at least one curing agent.

The disclosure also provides a kit comprising:

a component (A) comprising:

(i) 20 to 60 wt% of at least one bisphenol F epoxy resin;

(ii) 2.0 to 15 wt% of at least one silane;

(iii) 0 to 20 wt% of at least one hydrocarbon resin; and

(iv) 1.0 to 15 wt% of at least one reactive diluent;

and a component (B) comprising at least one curing agent.

The disclosure also provides a kit comprising:

a component (A) comprising:

(i) 20 to 60 wt% of at least one bisphenol F epoxy resin;

(ii) 2.0 to 15 wt% of at least one silane;

(iii) 0 to 20 wt% of at least one hydrocarbon resin; and

(iv) 0 to 15 wt%, such as 1.0 to 15 wt%, of at least one reactive diluent;

and a component (B) comprising at least one curing agent.

Viewed from another aspect the disclosure provides a metal substrate having coated thereon a coating composition as herein before defined.

The disclosure also provides a substrate coated with a primer composition as herein before defined.

The disclosure also provides a substrate coated with a primer coating composition as herein before defined which has been cured.

Viewed from another aspect the disclosure provides use of coating composition as herein before defined for protecting a metal substrate.

The disclosure also provides a process for the preparation of a coating composition as herein before defined comprising blending components (A) and (B).

The disclosure also provides a process for the application of a coating composition to a substrate comprising blending components (A) and (B) to form a mixture and applying said mixture to a substrate, e.g. by airless spraying and optionally allowing said coating to cure.

The disclosure also provides a process for application of a coating composition to a substrate comprising (I) blending components (A) and (B) as hereinbefore defined to form a mixture and applying said mixture to a substrate, e.g. by airless spraying;

(II) before said mixture cures on said substrate, applying a second coating of said mixture onto the coated substrate;

optionally repeating step (II); and

(III) allowing the coating composition to cure.

In all examples it is preferred if the coating composition comprises 1.0 to 15 wt% of at least one reactive diluent.

In all examples it is preferred if the coating composition comprises 0.5 to 20 wt% of at least one hydrocarbon resin.

Claims

1. An ultra-high solids content primer coating composition comprising:

(i) 5.0 to 50 wt% of at least one bisphenol F epoxy resin;

(ii) 1.5 to 12 wt% of at least one silane;

(iii) 0 to 20 wt% of at least one hydrocarbon resin;

(iv) 1.0 to 15 wt% at least one reactive diluent; and

(v) at least one curing agent;

wherein said composition has a solids content of at least 90 wt% measured according to ASTM D5201-05;

wherein said composition has a viscosity of 200 to 800 cps at 23°C and 50% RH (ASTM D4287);

wherein the ratio between active hydrogen equivalents in the curing agent and epoxy equivalents of the coating composition is in the range 50:100 to 120:100; and wherein said silane is tris(3-trimethoxysilylpropyl) isocyanurate or is of general formula (I) or (II)

$$Y\text{-}R_{(4-z)}SiX_z \qquad (I) \qquad \text{or}$$

$$Y\text{-}R_{(3-y)}R^1SiX_y \qquad (II)$$

wherein z is an integer from 1 to 3,

wherein y is an integer from 1 to 2,

R is a hydrocarbyl group having 1 to 12 C atoms or a hydrocarbyl group having 1 to 12 C atoms containing an ether or amino linker,

R^1 is a hydrocarbyl group having 1 to 12 C atoms;

Y is a functional group bound to R that can react with corresponding curing agent or epoxy resin functionalities and

each X independently represents a halogen group or an alkoxy group.

2. An ultra-high solids content primer coating composition as claimed in claim 1 comprising 0.5 to 20 wt% of at least one hydrocarbon resin.

3. A coating composition as claimed in claim 1 to 2 wherein said composition has viscosity of 300-600 cps at 5°C, 50%RH.

4. A coating composition as claimed in any one of claims 1 to 3 wherein the bisphenol F has an epoxy equivalent weight of 300 or less.

5. A coating composition as claimed in any one of claims 1 to 4 wherein the silane is methacryloxypropyltrimethoxysilane, 3-mercaptopropyltri(m)ethoxysilane, 3-glycidoxypropyltrimethoxysilane, gamma-mercaptopropyltrimethoxysilane, beta-(3,4-epoxycyclohexyl)ethyltrimethoxysilane, gamma-isocyanatopropyltrimethoxysilane, (methacryloxymethyl)trimethoxysilane, isocyanatomethyltrimethoxysilane, N-(2-aminoethyl)-3-aminopropyltrimethoxysilane, N-(2-aminoethyl)-3-aminopropyltriethoxysilane, diethylenetriaminopropyltrimethoxysilane, bis(gamma-trimethoxysilylpropyl)amine, N-ethyl-gamma-aminoisobytyltrimethoxysilane, N-phenyl-gamma-aminopropyltrimethoxysilane, 4-amino-3,3-dimethylbutyltrimethoxysilane, (N-cyclohexylaminomethyl)triethoxysilane, (N-phenylaminomethyl)trimethoxysilane, 3-Aminopropyltriethoxysilane, 3-Aminopropyltrimethoxysilane, N-(Aminoethyl)-aminopropyltrimethoxysilane, 3-aminopropylmethyldiethoxysilane, 3-(2-aminoethylamino)propylmethyldimethoxysilane, ($H_2NCH_2CH_2NHCH_2CH_2CH_2SiCH_3(OCH_3)_2$), [3-(2,3-Epoxypropoxy)propyl]triethoxysilane, [3-(2,3-Epoxypropoxy)propyl]trimethoxysilane, and mixures thereof.

6. A coating composition as claimed in any one of claims 1 to 5 wherein the silane is an epoxy functional silane.

7. A coating composition as claimed in any one of claims 1 to 6 wherein the silane is 3-glycidyloxypropyltrimethoxysilane.

8. A coating composition as claimed in any one of claims 1 to 7 wherein said composition has a solvent content of less than 5 wt%.

9. A coating composition as claimed in any one of claims 1 to 8 wherein the silane forms 2.0 to 10 wt% of the coating composition and/or the hydrocarbon resin forms 2 to 10 wt% of the coating composition.

10. A coating composition as claimed in any one of claims 1 to 9 wherein the reactive diluent is 1,6-hexanediol diglycidyl ether or 1,4-butanediol diglycidyl ether.

11. A coating composition as claimed in any one of claims 1 to 10 wherein coating composition has a solids content of at least 95%.

12. A coating composition as claimed in any one of claims 1 to 11 wherein the curing agent is phenalkamine or is a polyamine curing agent.

13. A coating composition as claimed in any one of claims 1 to 12 wherein the reactive diluent has a viscosity of 50 cPs or less.

14. A coating composition as claimed in any one of claims 1 to 13 wherein the reactive diluent is an aliphatic reactive diluent and is difunctional.

15. A coating composition as claimed in any one of claims 1 to 14 having a pot life at 23 ºC of more than 70 minutes.

16. A coating composition as claimed in any one of claims 1 to 15 having a cone and plate viscosity below 500 cPs measured at 23 ºC.

17. A coating composition as claimed in any one of claims 1 to 16 having a VOC of 100g/L or less.

18. A kit suitable for the preparation of a coating composition as defined in claim 1 comprising a component (A) comprising:

(i) 20 to 60 wt% of at least one bisphenol F epoxy resin;

(ii) 2.0 to 15 wt% at least one silane which is tris(3-trimethoxysilylpropyl) isocyanurate or of general formula (I) or (II)

$Y\text{-}R_{(4-z)}SiX_z$ (I) or

$Y\text{-}R_{(3-y)}R^1SiX_y$ (II)

wherein z is an integer from 1 to 3,

wherein y is an integer from 1 to 2,

R is a hydrocarbyl group having 1 to 12 C atoms or a hydrocarbyl group having 1 to 12 C atoms containing an ether or amino linker,

R^1 is a hydrocarbyl group having 1 to 12 C atoms;

Y is a functional group bound to R that can react with corresponding curing agent or epoxy resin functionalities; and

each X independently represents a halogen group or an alkoxy group;

(iii) 0 to 20 wt% of at least one hydrocarbon resin; and

(iv) 1.0 to 15 wt%, at least one reactive diluent;

and a component (B) comprising at least one curing agent;

wherein, when components (A) and (B) are combined, the resulting coating composition has a solids content of at least 90 wt% measured according to ASTM D5201-05;

wherein said composition has a viscosity of 200 to 800 cps at 23°C and 50% RH (ASTM D4287); and

wherein the ratio between active hydrogen equivalents in the curing agent and epoxy equivalents of the coating composition is in the range 50:100 to 120:100.

19. A kit as claimed in claim 18 wherein said hydrocarbon resin comprises the reaction product of formaldehyde with 1,3-dimethylbenzene.

20. A metal substrate having coated thereon a coating composition as claimed in any one of claims 1 to 17.

21. Use of coating composition as claimed in any one of claims 1 to 17 for protecting a metal substrate.