

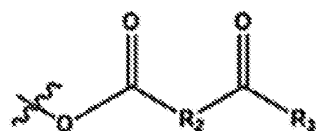
CLAIMS

What is claimed is:

1. A flexible resin system for epoxy intumescent coating compositions comprising:

at least one epoxy resin and an acetoacetate polyacetatoacetate (AcAc) functional polymer combined with an amine functional curing agent to form a cured flexible resin system that cures within 24 hours with a shore D hardness of at least 2.5;

wherein the AcAc functional polymer includes at least one terminal AcAc unit as follows:



in which R_2 is $-\text{CH}_2-$ and R_3 is $-\text{CH}_3$; and

wherein the cured flexible resin system: (i) when equilibrated to -60°C , does not crack after a manual bend test, and (ii) when immersed in water for at least 5 days, gains less than 7.5 wt.% (relative to a dry weight of the coating prior to being immersed).

2. The resin system according to claim 1 wherein the cured flexible resin system cures within 24 hours at 23°C with a shore D hardness of at least 5.0 and, when immersed in water for at least 5 days, gains less than 5.0 wt.% (relative to a dry weight of the coating prior to being immersed).

3. The resin system according to claim 1 wherein the AcAc functional polymer is at least one selected from: an polyester block copolymer, a dimer fatty acid/polyester block copolymer, and an adduct, modification, or derivative thereof.

4. The resin system according to claim 1 wherein the at least one epoxy resin is selected from: bisphenol A diglycidyl ether epoxide resin; bisphenol F diglycidyl ether epoxide resin; epoxidized polyurethane, oxymethylene bisoxirane resin; epoxidized alkyl phenols, epoxidized polyglycol diglycidyl ether, bis- and oxirane bisphenol A diglycidyl ether resins; epoxidized dimer acid; oleic acid; linoleic acid; erucic acid; epoxidized trimer fatty acid;

ethoxylated or propoxylated methacrylate monomers; bisphenol A, F, and A/F epoxy, epoxy phenolic, novolac resins; epoxy cresol novolac resin; epoxidized castor oil triglycidyl ether; epoxidized phenyleneoxy[1-(butoxyethyl)ethylene, di-functional glycidyl ether; C13, C15-alkyl glycidyl ether; poly tetramethylene ether glycol; polypropylene glycol copolymers; and any combination of two or more thereof.

5. The resin system according to claim 1 wherein the amine functional curing agent is selected from: polyamine, polyamide, polyamidoamine, aliphatic amine, phenalkamine, polyetheramine modified phenalkamine, dimer-diamine mixtures comprising C36 Dimeric diamine, C18 amine, and C54 Trimeric amine, cycloaliphatic polyamine, polyetherpolyamine, alkyletheramine, polyethylenimine, fatty alcohol adducted polyetheramine, polyetherurethanamine, polyether-urethanepolyamine, polyurethaneamine, polyetheramine, polyetheramide, polypropyleneamide, polypropyleneamine, polyamide made by reacting with dimer fatty acids, phenalkamide, polyamidoimidazoline, polyetherpolyamides, polyaminoamide, any combination of two or thereof, and adducts or modifications thereof

6. The resin system according to claim 5 further comprising a catalyst selected from: dipropylenetriamine, benzyldimethylamine, n,n-dimethylpropylamine, bis(dimethylaminoethyl)ether, bis-n,n-dimethylethanolaminether, 1,3-propanediamine, 1,3-bis[3-(dimethylamino)propyl]urea, N'-(3-(dimethylamino)propyl)-N,N-dimethyl, 1,4-diazabicyclooctane (DABCO), 2-(2-(2-dimethylaminoethoxy)-ethylmethylamino)-ethanol, 1,8-diazabicyclo[5.4.0]undec-7-en (DBU), 1,3-propanediamine, N'-(3-(dimethylamino)propyl)-N,N-dimethyl, 1,5-diazabicyclo[4.3.0]non-5-en, 1,1,3,3-tetramethylguanidine, N,N,N',N'',N''-pentamethyldiethylenetriamine, triphenylphosphine, trioctylphosphine, nonylphenol, 2-ethyl-4-methylimidazole, 2,6-dimethylpyridine, N,N-bis-(2-hydroxyethyl)-3-methylaniline, dimethylphenylphosphine, methyldiphenylphosphine, triphenylphosphite, N,N,N',N'',N''-pentamethyl, dimethylaminopyridine, N-(3-

dimethylaminopropyl)-N,N-diisopropanolamine, styrenated phenols, Tris-(dimethylaminomethyl)phenol, and amino-n-propyldiethanolamine N,N,N',N'',N''-pentamethyl-dipropylenetriamine.

7. The resin system of according to claim 1 wherein the at least one epoxy resin is selected from: (a) a bisphenol A / epichlorohydrin derived epoxy resin (b) a multifunctional resin containing both epoxide groups and reactive unsaturation (c) an internally flexibilised bisphenol A / epichlorohydrin derived epoxy resin (d) a polyacetoacetate epoxy polyester (e) dimer fatty acid polyester block copolymer (f) polyurethane epoxy resin or (g) a cashew nut based and Castor Oil triglycidyl ether epoxy resin or can be a combination thereof.

8. The resin system according to claim 1 wherein the epoxy resin or resins account for between 10.00 and 70.00 wt.% of a total mass of the coating, the amine functional curing agent or agents account for between 5.00 and 60.00 wt.% of the total mass of the coating, and the AcAc functional polymer accounts for between 0.50 and 30.00 wt.% of the total mass of the resin system.

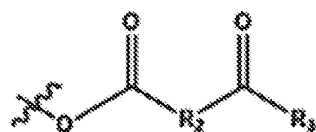
9. The resin system according to claim 1 further comprising:

an intumescent ingredient package including at least one of: an acid source, a carbon source, a gas source, and any combination thereof; and

an optional package including any one or combination of a nucleating agent, fibres, a plasticiser, rheology modifiers, and wetting/dispersion additives.

10. The resin system according to claim 9 wherein the at least one epoxy resin is provided at 10.00 to 70.00 wt.%, the AcAc functional polymer is provided at 0.50 to 30.00 wt.%, the amine functional coating agent is provided at 5.00 to 60.00 wt.%, and the intumescent ingredient package and the optional package (if present) are cumulatively provided at least 5.00 wt.% up to a remainder of wt.% and wherein all wt.% are relative to the total mass of the resin system.

11. The resin system according to claim 1 wherein the cured coating has a thickness of at least 20 mm.
12. The resin system according to claim 1 wherein the AcAc functional polymer is provided as part of the epoxy resin so that the epoxy resin includes the at least one terminal AcAc unit.
13. An intumescent coating composition resistant to cracking at -60° C and water absorption, the composition comprising:
- a first part comprising at least one epoxy resin, an acetoacetoxypolyacetoacetate (AcAc) functional polymer, and an optional liquid plasticizer;
 - a second part comprising at least one amine functional curing agent including polyamide having an H eq.wt. between 90 and 110, and an optional liquid plasticizer;
 - an intumescent ingredient package including an acid source, an optional a carbon source, and a gas source; and
- wherein the AcAc functional polymer includes a terminal AcAc unit as follows

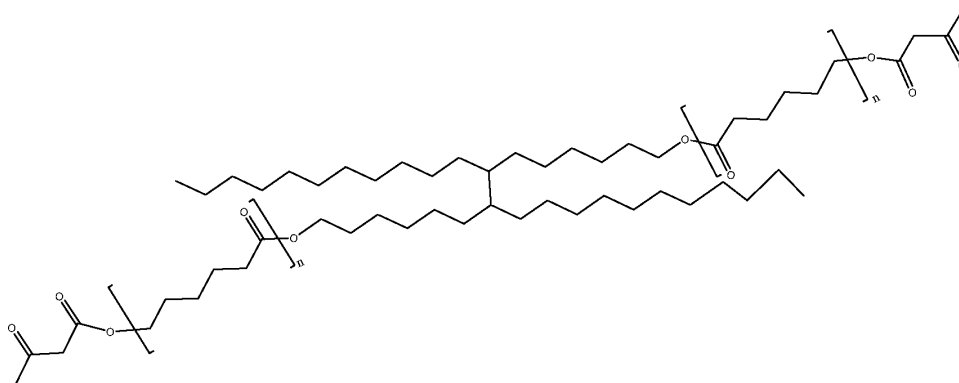


in which R₂ is -CH₂- and R₃ is -CH₃.

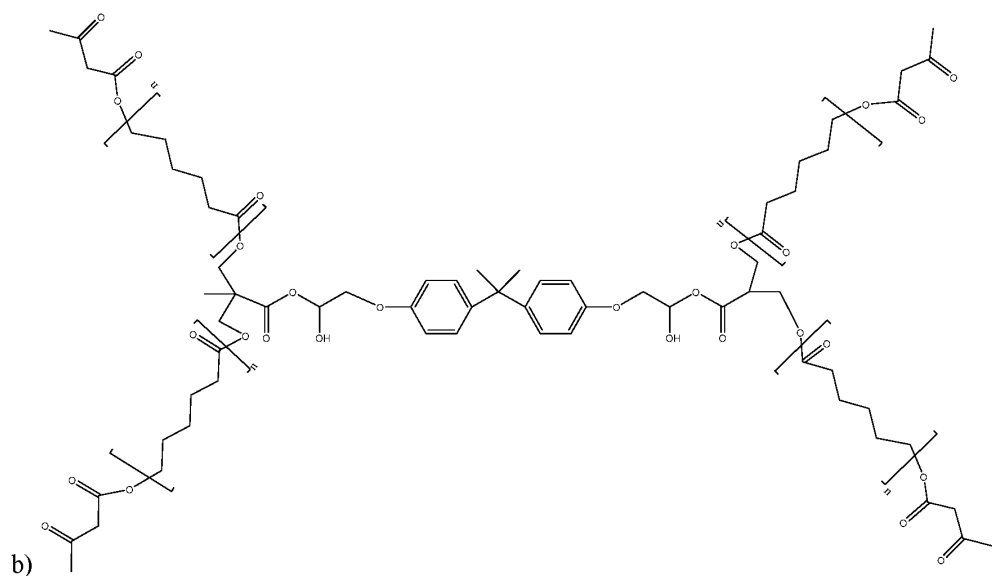
14. The intumescent coating composition according to claim 13 wherein the intumescent ingredient package further comprises at least one of: a nucleating agent, fibres, a plasticiser, rheology modifiers, wetting/dispersion additives, and any combination thereof.
15. The intumescent coating composition according to claim 13 wherein every chain in the AcAc functional polymer ends with the terminal AcAc unit.
16. The intumescent coating composition according to claim 13 wherein the AcAc functional polymer consists of at least 0.50 wt.% relative to a combined mass of the composition.

17. The intumescent coating composition according to claim 16 wherein the AcAc functional polymer consists of about 5.00 to about 25.00 wt.% relative to the combined mass of the composition.
18. The intumescent coating composition according to claim 13 wherein the at least one amine functional curing agent consist of at least 5.00 wt.% relative to a combined mass of the composition.
19. The intumescent coating composition according to claim 18 wherein the amine functional curing agents consist of about 15.00 to about 30.00 wt.% relative to the combined mass of the composition.
20. The intumescent coating composition according to claim 13 wherein the at least one epoxy resin consists of at least 10.00 wt.% relative to a combined mass of the composition.
21. The intumescent coating composition according to claim 20 wherein the at least one epoxy resin consists of about 15.00 to about 25.00 wt.% relative to the combined mass of the composition.
22. The intumescent coating composition according to claim 13 wherein the at least one epoxy resin is derived from bisphenol A.
23. The intumescent coating composition according to claim 13 wherein the amine functional curing agent includes polytetramethylene ether glycol-based polyether amines having an H eq wt between 500 and 770.
24. The intumescent coating composition according to claim 13 wherein the the AcAc functional polymer has a structure selected from at least one of:

a)

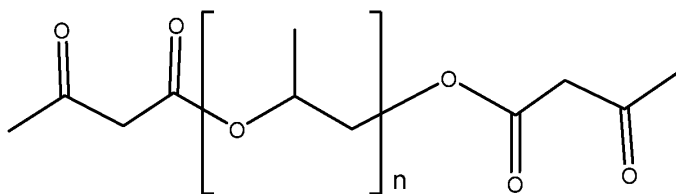


wherein n is at least 3; and



wherein n is at least 3.

25. The intumescent coating composition according to claim 13 wherein the the AcAc functional polymer is



wherein n is any integer from 8 to 68.

26. The intumescent coating composition according to claim 13 wherein the AcAc functional polymer is integrated with the epoxy resin so that the epoxy resin includes the at least one terminal AcAc unit.