considerations. The benzyl alcohol as volatile substance causes migration effects and declines the glass transition temperature of the cured epoxy resin, which is a critical property for many applications.

EP 0 126 625 A2 describes a phenolic product prepared by reacting a phenol compound substituted with OH, C1-8 alkyl or alkenyl or a phenyl group, a $-C(CH_3)_2C_6H_5$ group or a $-C(CH_3)_2C_6H_4OH$ group with a benzene compound substituted with two independent occurrences of $-C(CH_3)CH_2$ or $-C(CH_3)_2OH$ in the presence of an acidic catalyst.

US 9 074 041 B2 describes a curable epoxy resin composite formulation for preparing a composite shaped article comprising a reinforcing material and an epoxy resin composition comprising at least one epoxy resin having an average of more than one glycidyl ether group per molecule, at least one alkanolamine curing agent and at least one styrenated phenol.

US 9 464 037 describes an adduct of styrenated phenols and hydroxylamines as well as a method of its synthesis. The resin is prepared via an acid catalyzed alkylation reaction.

SUMMARY ~~OF THE INVENTION~~

The object of the ~~invention~~ disclosure is regarded in the provision of an accelerator for epoxy resins that does not have the disadvantages shown above. In particular, a nonvolatile, non-toxic polymeric accelerator system for curing of epoxy resins with comparable or improved acceleration properties like the prior art accelerators would be desirable.

In one aspect, ~~T~~this object is solved with an epoxy system comprising
an epoxy resin and

and wherein

R^1 is H, C_{1-15} alkyl, or C_{1-15} oxyalkyl, or $C_6H_5(CR^{18}R^{19})_o$-Z-, preferably H, C_{1-15} alkyl, or C_{1-15} oxyalkyl,

R^2, R^4, R^6, R^7, R^8, R^9, R^{11} and R^{12} are independently from each other H or C_{1-5} alkyl,

R^3 and R^5 are H, OH, NO_2, halogen, C_{1-5} alkyl or C_{1-5} oxyalkyl,

R_{10} and R_{13} are C_{1-5} alkyl or C_{5-6} cycloalkyl,

R_{14} is C_{5-12} cycloalkyl, optionally substituted with a methyl or an ethyl group,

R^{15}, R^{16}, and R^{17} are independently from each other H or C_{1-5} alkyl, preferably $–CH_3$,

R^{18} and R^{19} are independently of each other H or CH_3

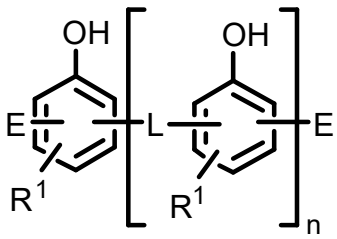
Z is a covalent bond or –O-,

o is 1 or 0,

m is an integer from 1 to 7 and

n is an integer of from 2 to 21.

In another aspect, ~~T~~the ~~invention~~ disclosure is furthermore directed to the use of a phenolic polymer ~~having~~ comprising a number average molar mass (M_n) of from 200 to 1,500 g/mol comprising a phenol compound, a linker group L and end group E, said phenolic polymer having the structure as presented in formula 1 below:



Formula 1

wherein the linker group L has the meaning of

o is 1 or 0,

m is an integer from 1 to 7 and

n is an integer of from 2 to 21

as an accelerator for the curing of epoxy resins, in particular in the presence of a hardener comprising amine functionalities

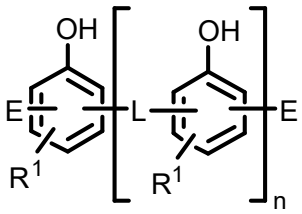
or

as a hardener for epoxy resins, in particular in the presence of a co-hardener comprising amine functionalities.

In another aspect, ~~T~~the ~~invention~~ disclosure is furthermore directed to a kit of parts comprising

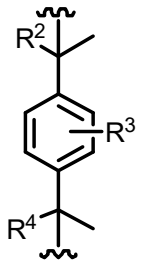
an epoxy resin and

a phenolic polymer having a number average molar mass (M_n) of from 200 to 1,500 g/mol comprising a phenol compound, a linker group L and end group E, said phenolic polymer having the structure as presented in formula 1 below:

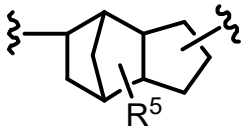


Formula 1

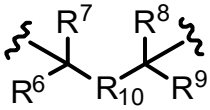
wherein the linker group L has the meaning of



or

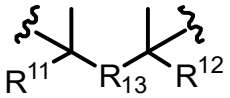


or



or

Formula 2 Formula 3 Formula 4



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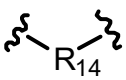
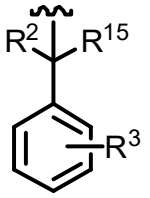


Formula 5 Formula 6

each end group E has the meaning of H or is a group of formula 2, 3, 4, 5 or 6 with only one bond to a phenol compound in formula 1 or has the meaning of



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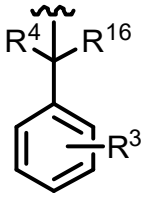

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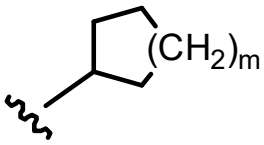
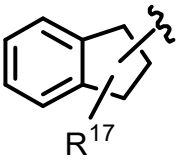


or



Formula 2c1 Formula 2c2 Formula 3c1 Formula 3c2

and wherein

R^1 is H, C_{1-15} alkyl, or C_{1-15} oxyalkyl, or $C_6H_5(CR^{18}R^{19})_o$-Z-, preferably H, C_{1-15} alkyl, or C_{1-15} oxyalkyl,

R^2, R^4, R^6, R^7, R^8, R^9, R^{11} and R^{12} are independently from each other H or C_{1-5} alkyl,

R^3 and R^5 are H, OH, NO_2, halogen, C_{1-5} alkyl or C_{1-5} oxyalkyl,

R_{10} and R_{13} are C_{1-5} alkyl or C_{5-6} cycloalkyl,

R_{14} is C_{5-12} cycloalkyl, optionally substituted with a methyl or an ethyl group,

R^{15}, R^{16}, and R^{17} are independently from each other H or C_{1-5} alkyl, preferably $-CH_3$,

R^{18} and R^{19} are independently of each other H or CH_3

Z is a covalent bond or –O-,

o is 1 or 0,

m is an integer from 1 to 7 and

n is an integer of from 2 to 21, and

a hardener comprising amine, anhydride, phenolic, and/or thiol, in particular amine, functionalities.

The phenolic polymer according to the ~~invention~~ disclosure accelerates the curing of epoxy resins, for example in adhesive systems or in coatings. The hardened epoxy resins have good mechanical properties and also good chemical resistivity.

It was further found that using the phenolic polymer according to the ~~invention~~ disclosure in epoxy systems or kit-of-parts according to the ~~invention~~ disclosure or as an accelerator may provide controlled acceleration properties in epoxy resins. At the same time, the phenolic polymer according to the ~~invention~~ disclosure may not result in the reduction of the mechanical strength of epoxy systems. Moreover, it was found that epoxy resins or epoxy systems comprising the phenolic polymer according to the ~~invention~~ disclosure may have a high mechanical resistance. Further, epoxy resins or epoxy systems comprising the phenolic polymer according to the ~~invention~~ disclosure may have a high chemical resistance. Epoxy resins or epoxy systems, in particular cured epoxy systems, comprising the phenolic polymer according to the ~~invention~~ disclosure may also have a high glass transition temperature (T_g). Epoxy resins or epoxy systems, in particular cured epoxy systems, comprising the phenolic polymer according to the ~~invention~~ disclosure may also have a high thermal stability. Lastly, epoxy resins or epoxy systems, in particular cured epoxy systems, comprising the phenolic polymer according to the ~~invention~~ disclosure may have an improved adhesion to metal and mineral surfaces and/or a higher corrosion resistance.

PREFERRED EMBODIMENTS OF THE INVENTION

The phenolic polymer according to the invention may also be referred to as a terpolymer.

In the following, the components in the phenolic polymer and its properties are first described further.

According to a preferred embodiment of the invention, R^1 is H, $C_{1\text{-}10}$ alkyl, in particular $C_{1\text{-}8}$ alkyl, more particularly $C_{1\text{-}5}$ alkyl, or $C_{1\text{-}10}$ oxyalkyl, in particular $C_{1\text{-}8}$ oxyalkyl, more particularly $C_{1\text{-}5}$ oxyalkyl.