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CURING OF DIGLYCIDAL ESTERS OF BISPHENOLS WITH AMINE HARDENERS

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ABSTRACT

The effect of hardeners on the properties of cured epoxy polymers is studied. For the purpose of synthesis of polymers with increased thermal properties. Theglycide esters of polycyclic bisphenols synthesized by us were used as a diol component. Since the thermal and heat resistance of polymers, in addition to the chemical structure of bisphenols, also depend on the structure of the hardener used, amine hardeners of different chemical structure are used to improve the thermal parameters of polymers, both heat resistance and heat resistance. The influence of the chemical structure of these hardeners on the properties of epoxy polymers is studied.

Cured epoxy polymers are characterized by high heat resistance. High heat resistance results are obtained by 4,4′-diaminodiphenylsulfone, benzidine, 4,4′-diaminodiphenyloxide and other aromatic diamines.

Polymers obtained by curing with these hardeners are deformed in the temperature range of 220-245°C.

The use of the above hardeners gives high results in terms of heat resistance. In all cases, the polymers obtained on the basis of these hardeners decrease in weight by 10% in the temperature range of 340-400°C.

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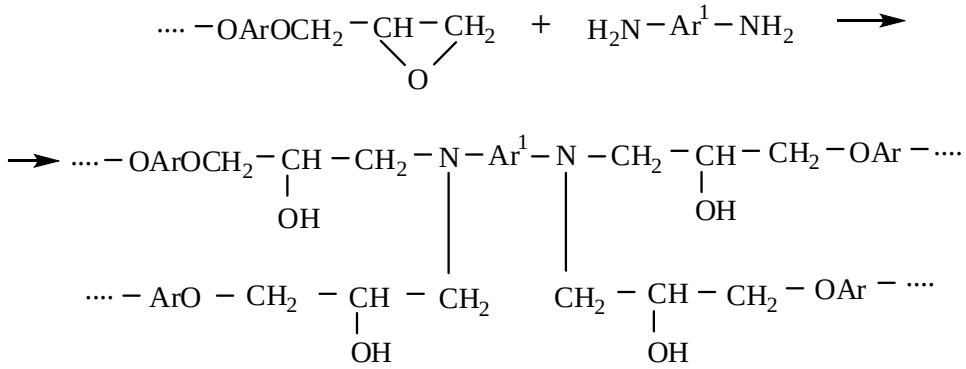
In works [1-7], epoxy polymers based on various bisphenols are described. Continuing research in the field of this interesting, practically important class of polymers, it was considered interesting to synthesize polymers with increased thermal properties. It was found that the presence of cyclic groups in the diol component, both aromatic and alicyclic in nature, largely determines the properties of the structured polymer, contributing to the growth of thermal parameters of polymers. Components containing various cyclic groups were used as hardeners. Since the thermal and heat resistance of polymers, in addition to the chemical structure of bisphenols, also depend on the

structure of the hardener used, amine hardeners of different chemical structure were used to improve the thermal properties of polymers, both heat resistance and heat resistance. The influence of the chemical structure of hardeners on the properties of epoxy polymers was studied.

The structure of the final product obtained by curing the glycide ester of bisphenol with amine can be represented as follows:

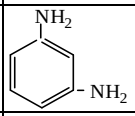
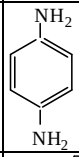
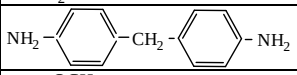
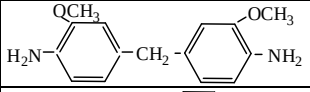
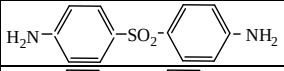
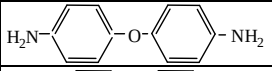
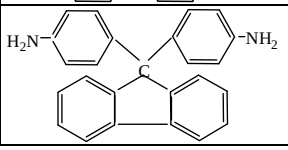


Where Ar^1 - is a residue of a diamine molecule,

Ar - is the remainder of the bisphenol molecule.

Table 1 and Figures 1 - 3, as an example, show the properties of polymers obtained on the basis of the glycide ether 4,4′-(2-norbornylmethylene)diphenol and various amine hardeners.

Table 1. Properties of structured polymers based on glycide ether 4,4′-(2-norbornylmethylene)diphenol and various amine hardeners.

№	Structure of the hardener	Name of the hardener	The amount of hardener per 100 glycide ether, is prepared	10% deformation according to the thermomechanical curve, °C	The temperature of mass reduction by 10%, °C**
1	ПО - 300	PolyethylenePolyamine	27.1	-	250
2		M-phenylenediamine	13.0	210	360
3		P-phenylenediamine	14.0	170	220
4		4,4' - diaminophenylmethane	19.0	145	390
5		4,4'-diamino-3,3' - dimethoxydiphenylmethane	25.0	150	340
6		4,4' - diaminodiphenylsulfone	24.8	235	400
7		4,4' - diaminodiphenyloxide	21.5	205	330
8		benzidine	18.1	195	325
9		AnilineFluorene	17.1	200	295

*Here and in the following table, the conditions for curing glycide ether are as follows: 120°C-2 hours, 160°C-3 hours, 180°C-3 hours, 200°C-5 hours.

** Here and in the following table, the temperature of mass reduction by 10% is determined from the thermogravimetric curve at a temperature rise rate of 4.50 S/min.

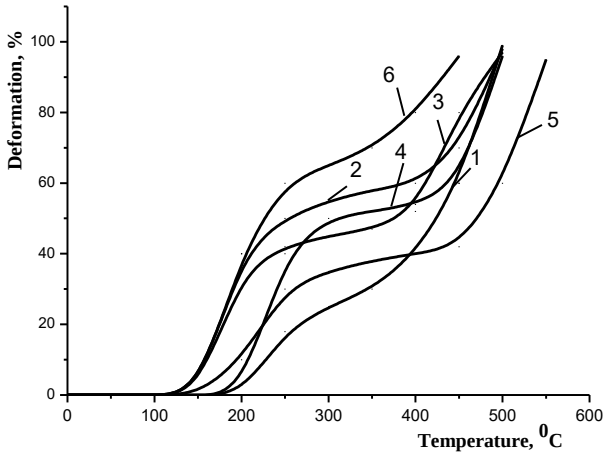


Fig. 1. Thermomechanical curves of epoxy polymers based on 4,4'-(2-norbornylmethylene)diphenol. Hardeners: 1.4,4'-diaminodiphenylsulfone, 2. Benzidine, 3. 4,4'-diaminodiphenylmethane, 4. Aniline fluorene, 5. M-phenylenediamine, 6. P-phenylenediamine

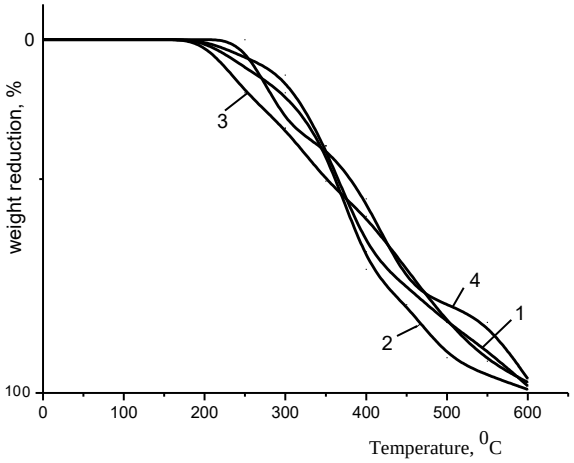


Fig. 2. Thermogravimetric curves of epoxy polymers based on the glycide ether 4,4'-(2-norbornylmethylene)diphenol. Hardeners: 1. 4,4'-diaminodiphenylsulfone, 2. Benzidine, 3. Aniline fluorene, 4. Polyethylene polyamine.

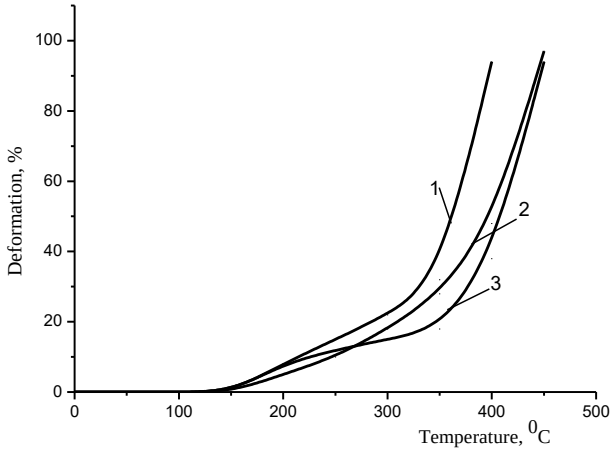


Fig. 3. Thermomechanical curves of epoxy polymers based on 4,4-(3-methyl-2-norbornylmethylene)diphenol. Hardeners: 1. 4,4'-diaminodiphenylsulfone, 2. 4,4'-diaminodiphenyloxide, 3. Benzidine

As can be seen from the data in the table and figures, cured epoxy polymers are characterized by a fairly high heat resistance. The exception is polymers obtained by curing 4,4′-diamino-3,3′-

dimethoxydiphenylmethane and 4,4′-diaminodiphenyl-methane, whose heat resistance is equal to 145 and 150°C. This is obviously due to the structure of the above - mentioned diamines, namely, the presence of methoxy-and methylene groups in their molecules. 4,4′-diaminodiphenylsulfone gives high results in heat resistance. Polymers obtained by curing with these hardeners are deformed in the temperature range of 220-245°C.

The use of the hardeners listed in Table 1 gives high results in terms of heat resistance. In all cases, the polymers formed by curing these components decrease in mass by 10% in the temperature range 340-400°C. The only exception is the polymer obtained by curing the glycide ether with polyethylene polyamine. The temperature of reduction in mass by 10% for it is 260°C. The use of 4,4′-diaminodiphenylsulfone for curing glycide ether gives a high result. The temperature of the mass reduction by 10% at the same time increases to 400°C.

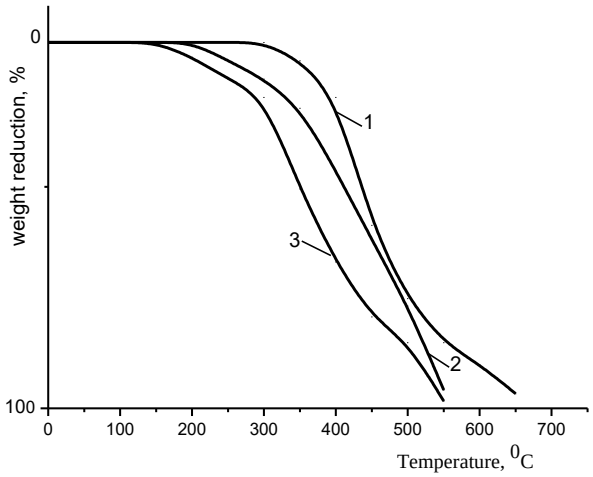
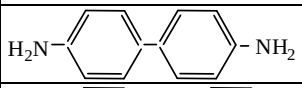
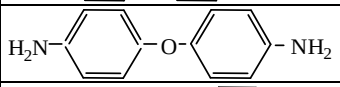
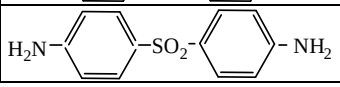


Fig. 4. Thermogravimetric curves of epoxy polymers based on the glycide ether 4,4′-(3-methyl-2-norbornylmethylene)diphenol.
Hardeners:1. 4,4'-diaminodiphenylsulfone, 3. 4,4'-diaminodiphenyloxide, 4. Benzidine

Table 2. Properties of structured compounds based on glycide esters 4,4′-(2-norbornylmethylene)diphenol (1) and 4,4′-(3-methyl-2-norbornylmethylene)diphenol (2).

№	Structure of the hardener	The amount of hardener per 100 glycide ether, is prepared		10% deformation according to the thermomechanical curve, °C		The temperature of mass reduction by 10%, °C**	
		1	2	1	2	1	2
1		20,0	17,3	195	260	325	300
2		19,7	16,2	205	210	330	300
3		24,5	25,9	225	235	400	280

Based on the results obtained, some of the hardeners listed in Table 1 were selected for the purpose of curing the glycide esters of 4,4′-(2-norbornylmethylene)diphenol and 4,4′-(3-methyl-2-norbornylmethylene)diphenol. Table 2 and Figures 4 show the properties of polymers obtained by curing the above glycide esters with the following hardeners: 4,4′-diaminodiphenyl-sulfone, benzidine and 4,4′-diaminodiphenyl oxide.

Based on these data, the thermal heat resistance of the cured polymers does not change significantly compared to the polymers obtained by curing the glycide ether of 4,4′-(3-methyl-2-norbornylmethylene)diphenol. Obviously, the change in the structure of the cyclic group does not affect these indicators.

Epoxy polymers obtained by curing glycide esters of cyclic bisphenols with these hardeners are characterized by high heat and heat resistance, which causes some practical interest. You should only pay attention that the heat and heat resistance of ester of 4,4′-(3-methyl-2-norbornylmethylene)diphenol is slightly higher than polymers based on other bisphenols.

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