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CURING OF DIGLYCIDAL ESTERS OF BISPHENOLS WITH ACID HARDENERS

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ABSTRACT

The unique properties of epoxy polymers have led to their wide application in various fields of modern technology. The influence of the structure of bisphenols on the properties of epoxy polymers, especially thermal ones, is known. However, the chemical structure of the hardener also affects the properties of cured epoxy polymers. As hardeners, we used acid hardeners of various structures: anhydrides of maleic, phthalic, pyromellite, methyltetrahydrophthalic and other acids. The following hardeners give high results in heat resistance: pyromellite and methyltetrahydrophthalic anhydrides. Polymers obtained by curing with these hardeners are deformed in the temperature range of 220-245°C. The use of these hardeners gives high results in terms of thermal stability. These polymers are formed by curing these components.

It is known that the properties of epoxy polymers depend on the chemical structure of the glycide ether. There was some interest in investigating the influence on the properties of epoxy polymers as a chemical structure, as well as the nature of hardeners. For this purpose, diglycidal esters based on bisphenols were synthesized.

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It is known that the properties of epoxy polymers depend on the chemical structure of the glycide ether [1-7]. There was some interest in investigating the influence on the properties of epoxy polymers as a chemical structure, as well as the nature of hardeners. For this purpose, diglycidal esters based on bisphenols were synthesized. Table 1 shows the characteristics of diglycidal esters.

Table 1. Characteristics of diglycidal esters of bisphenols

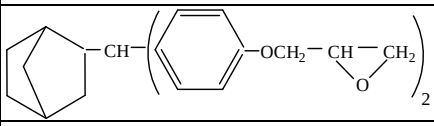
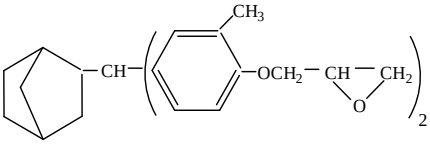
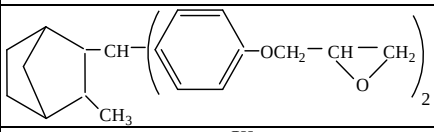
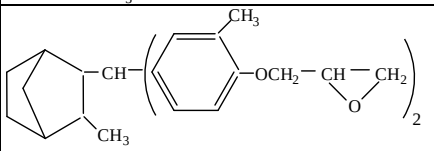
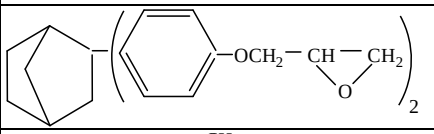
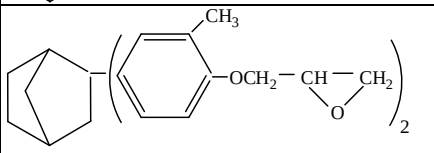
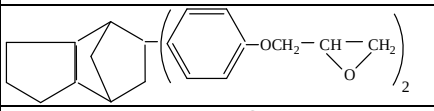
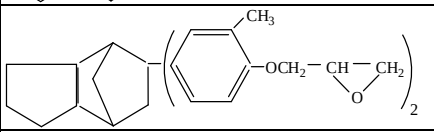
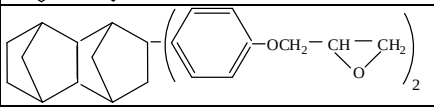
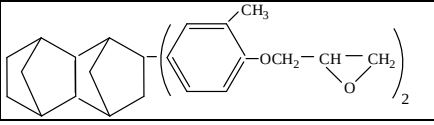
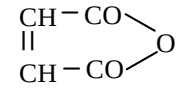
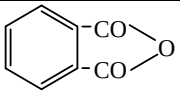
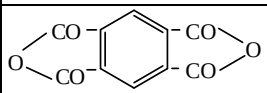
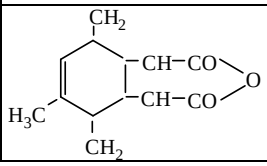
№	Structure of glycide ether	Temperature softening, °C	Content of epoxy groups, %		Molecular weight	
			calculated	found	Intheory	Determine dbyebullioscopy
1		61	21.23	19.00	405	424
2		69	20.04	18.86	429	406
3		71	20.62	20.02	419	422
4		75	19.23	18.6	449	505
5		55	21.9	17.0	392	480
6		75	20.4	17.5	420	505
7		65	19.9	15.1	432	612
8		65	18.6	17.4	460	472
9		83	18.7	14.0	458	508
10		75	17.9	15.3	486	530

Table 2 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 acid hardeners.

Table 1. Properties of structured polymers obtained on the basis of 4,4′-(2-norbornylmethylene)diphenol glycide ether and various acid 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	2	3	4	5	6
1		Maleic anhydride	39,2	322	270
2		Phthalicanhydride	54,0	170	310
3		Pyromelliteanhydride	83,5	215	410
4		Methyltetrahydrophthalicanhydride	62,2	200	320

*Here and in the following tables] 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.

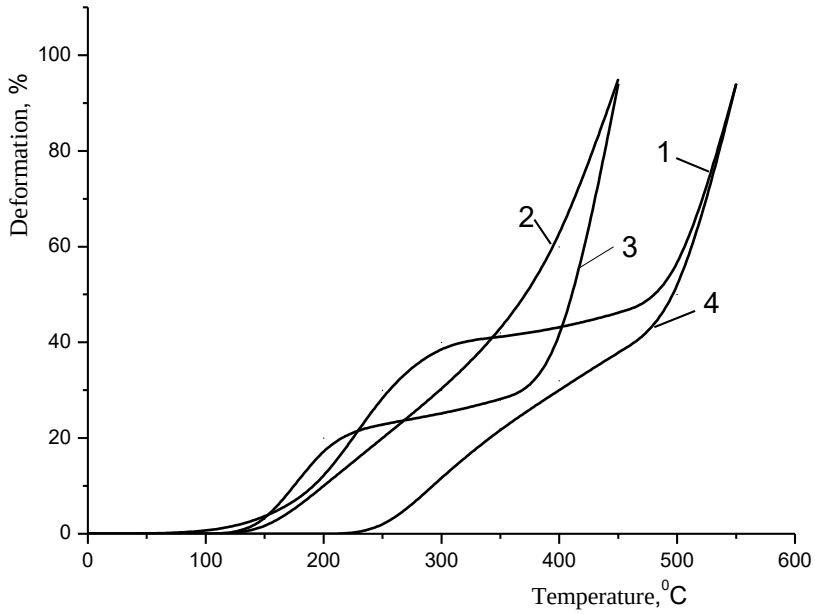


Fig. 1. Thermomechanical curves of epoxy polymers based on glycide 4,4′-(2norbornylmethylene)diphenol ether, hardeners: 1. methyltetrahydrophthalic anhydride, 2. pyromellite anhydride, 3. Phthalic anhydride, 4. maleic anhydride.

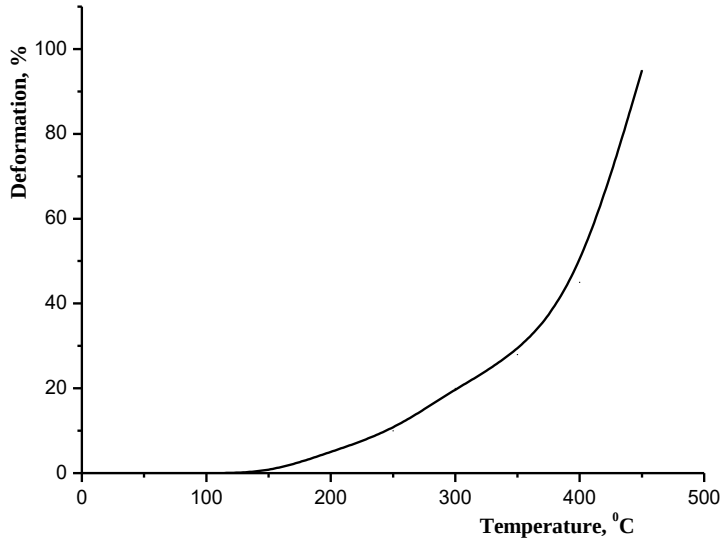


Fig. 2. Thermomechanical curve of an epoxy polymer based on glycide ether 4,4'-(3-methyl-2-norbornylmethylene)diphenol. The hardener is methyltetrahydrophthalic anhydride.

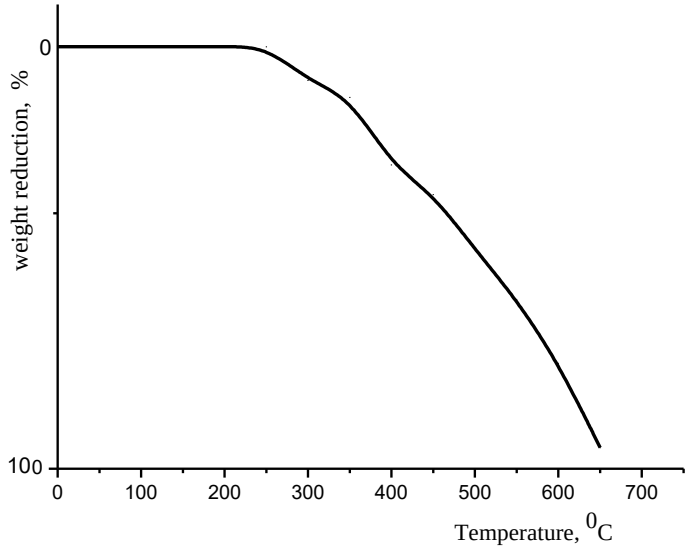


Fig. 3. Thermogravimetric curve of an epoxy polymer based on the glycide ether of 4,4'-(3-methyl-2-norbornylmethylene)diphenol. The hardener is methyl tetrahydrophthalic anhydride.

As can be seen from the data in the table and figures, cured epoxy polymers are characterized by a fairly high heat resistance. High results in heat resistance are given by the following hardeners:pyromellite and methyltetra-hydrophthalic anhydrides. Polymers obtained by curing with these hardeners are deformed in the temperature range of 220-245°C. It should be particularly noted that the polymers formed during curing with maleic anhydride are deformed at 310°C. This can obviously be explained by the formation of additional crosslinking due to the disclosure of the double bonds present in maleic anhydride.

The use of the hardeners listed in Table 2 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 of 340-400°C.

From the hardeners listed in Table 2, based on the results obtained by us, some 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 3 and Figures 2 and 3 show the properties of polymers obtained by curing the above glycide esters with methyltetrahydrophthalic anhydride.

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.

As the study showed, the epoxy polymers obtained by curing the glycide esters listed in Table 1 of cyclic bisphenols with these hardeners are characterized by high heat and heat resistance, which causes some practical interest. It is only necessary to pay attention to the fact, the ester of 4,4′-(3-methyl-2-norbornylmethylene)diphenol is slightly higher than that of polymers based on other bisphenols.

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