STUDY OF POLYMER COMPOSITE MATERIALS PROPERTIES UNDER THE INFLUENCE OF THERMO-OXIDATIVE DESTRUCTION

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Usually products of radio electronic equipment (REE) during operation are subjected to thermal effects in the presence of atmospheric oxygen.

Under these conditions, not purely thermal chain decomposition reactions take place, but thermal oxidation reactions. These processes can take place not only at elevated, but also at room temperatures, although the reaction rate decreases in this case. At the same time, thermooxidative degradation reactions play a certain role even at ordinary temperatures.

On the other hand, when structuring polymer composite materials (PCMs), when the process proceeds when the material is heated in an oxygen-containing medium, thermal oxidative degradation can manifest itself to a large extent.

Therefore, it is extremely important to investigate the change in the properties of the studied PCM (Table 1) under the influence of thermal-oxidative exposure for a long time.

Table 1 - Storage of studied PCM

Component	Quantity, % wt.		
	Compound		
	1	2	3
Epoxy oligomer ED-20	62	55	62
PEPA hardener	8	6	
Hardener UP-0633			20
DBP plasticizer	6		
Plasticizer MGF-9		10	

Table 2 shows comparative experimental data characterizing the change in the main physical-mechanical (a, σ bend) and operational (water absorption W, shrinkage L) properties of PCM based on epoxy binders structured by the traditional method and in the high-frequency field (HFF) under possible temperature conditions for the operation of REE. Considering the physical and mechanical parameters (a, σben), one can state their practical invariability for all compounds structured in both ways. Nevertheless, it can be seen from the table that the increased properties of PCM, achieved in the process of structuring in the HFF, in comparison with the properties of PCM structured by convection heating, are retained under conditions of thermal oxidative exposure. This fact makes it possible to predict an increased reliability in the operation of REE products sealed by the investigated PCMs structured in the HFF compared to PCMs structured in the traditional way.

Water absorption and shrinkage of PCM are one of the most important indicators that determine the reliability of the operation of REE elements. It can be seen from the data in Table 2 that these indicators are significantly lower for PCMs structured in the HFF compared to PCMs structured by convection heating, which also gives grounds to predict an increased reliability of REE elements sealed with PCMs structured in the HDFC field. The decrease in water absorption and shrinkage of the investigated PCMs with stable physical and mechanical properties indicates that the processes of thermal oxidative degradation do not manifest themselves under the studied conditions.

An increase in the residence time of PCM at elevated temperatures leads to a decrease in water absorption and shrinkage, which is obviously due to an increase in the degree of crosslinking, i.e. additional structuring of PCM at the studied temperatures.

Table 2.– Changes in the physical, mechanical and operational properties of PCM after exposure temperature

Index	Compound number		
	1	2	3
Impact strength, kJ/m^2			
original value			
after exposure:	5,6/8,8	5,9/9,6	6,6/8,4
at 85^{0}C for 30 hours	6,4/9,2	6,6/9,9	7,3/10,2
at 65^{0}C for 1000 hours	6,8/9,8	7,0/10,2	6,1/11,9
Breaking stress in bending, MPa			
original value	57,2/68,8	61,1/64,1	63,3/68,1
after exposure:	60,1/69,8	61,7/65,1	64,8/69,0
at 85^{0}C for 30 hours	58,3/69,9	62,6/64,5	64,4/69,7
at 65^{0}C for 1000 hours			
Water absorption in 24 hours,			
original value			
after exposure:	0,366/0,281	0,287/0,167	0,291/0,186
at 85^{0}C for 30 hours	0,318/0,218	0,273/0,151	0,280/0,182
at 65^{0}C for 1000 hours	0,203/0,107	0,265/0,095	0,254/0,080
Resizing,			
original value			
after exposure:	0,112/0,058	0,123/0,057	0,118/0,062
at 85^{0}C for 30 hours	0,101/0,042	0,099/0,053	0,103/0,051
at 65^{0}C for 1000 hours	0,104/0,39	0,116/0,042	0,109/0,046

Notes: 1 - The composition of the compounds is given in Table 1.; 2 - Numerator - convection method of curing, denominator - in the HFF.