STUDY EVALUATION OF ADHESION BETWEEN POLYMER AND REINFORCING FILLERS

Khalimov Shukhrat Abdurahimovich

- Candidate of Technical Sciences, Associate Professor of the Department of Technological Machines and Equipment, Namangan Engineering and Construction Institute, Namangan,

Republic of Uzbekistan

Nurmuhammadov Ravshan

master's student, Namangan Engineering and Construction Institute, Namangan,

Republic of Uzbekistan

Sadikov Muhammad Akramzhanovich

undergraduate, Namangan Engineering and Construction Institute, Namangan,

Republic of Uzbekistan

Khasanov Mazhidkhan Mukhmudkhanovich

Intern-teacher of the Department of Technological machines and equipment, Namangan Engineering and Construction Institute, Namangan,

Republic of Uzbekistan

The results of the study composite material happen to in article receive discrete unidirectional filament, allowing get the material with raised dempfir abilities and high springy - an toughness characteristic.

It is known that one of the effective methods for increasing the strength of composite polymer materials for high-pressure gas cylinders is their reinforcement with fibrous fillers of different nature and geometric parameters [1].

At the same time, it is especially important to ensure high adhesion in the interfacial layer matrix-filler. Unfortunately, at present, there are practically no methods and instruments for quantitative assessment of the adhesion value in the interfacial layer [2].

In this regard, for an indirect and qualitative assessment of the adhesion of binders and reinforcing fillers, a logarithmic damping decrement was used, which characterizes internal energy losses [3, 4].

The influence of the level of shear strain during bending vibrations of rod specimens on the damping capacity of unidirectional hybrid composite materials (HCM) based on a system of continuous low-modulus and discrete high-modulus fibers was studied. The research results are shown in the table.

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It can be seen from the data in the table that with an increase in the level of cyclic loading, the logarithmic decrement of vibrations of unidirectional glass-carbon-plastics and organic-carbon-plastics based on continuous low-modulus and discrete high-modulus carbon fibers increases, and the nature of the amplitude dependence of the logarithmic decrement of vibrations changes in comparison with unidirectional glass-carbon-plastics and organic-carbon-plastics based on continuous fibers. With an increase in the content of high-modulus carbon fibers, the increase in the logarithmic decrement of vibrations in fiberglass based on discrete carbon fibers is higher compared to a material based on continuous fillers.

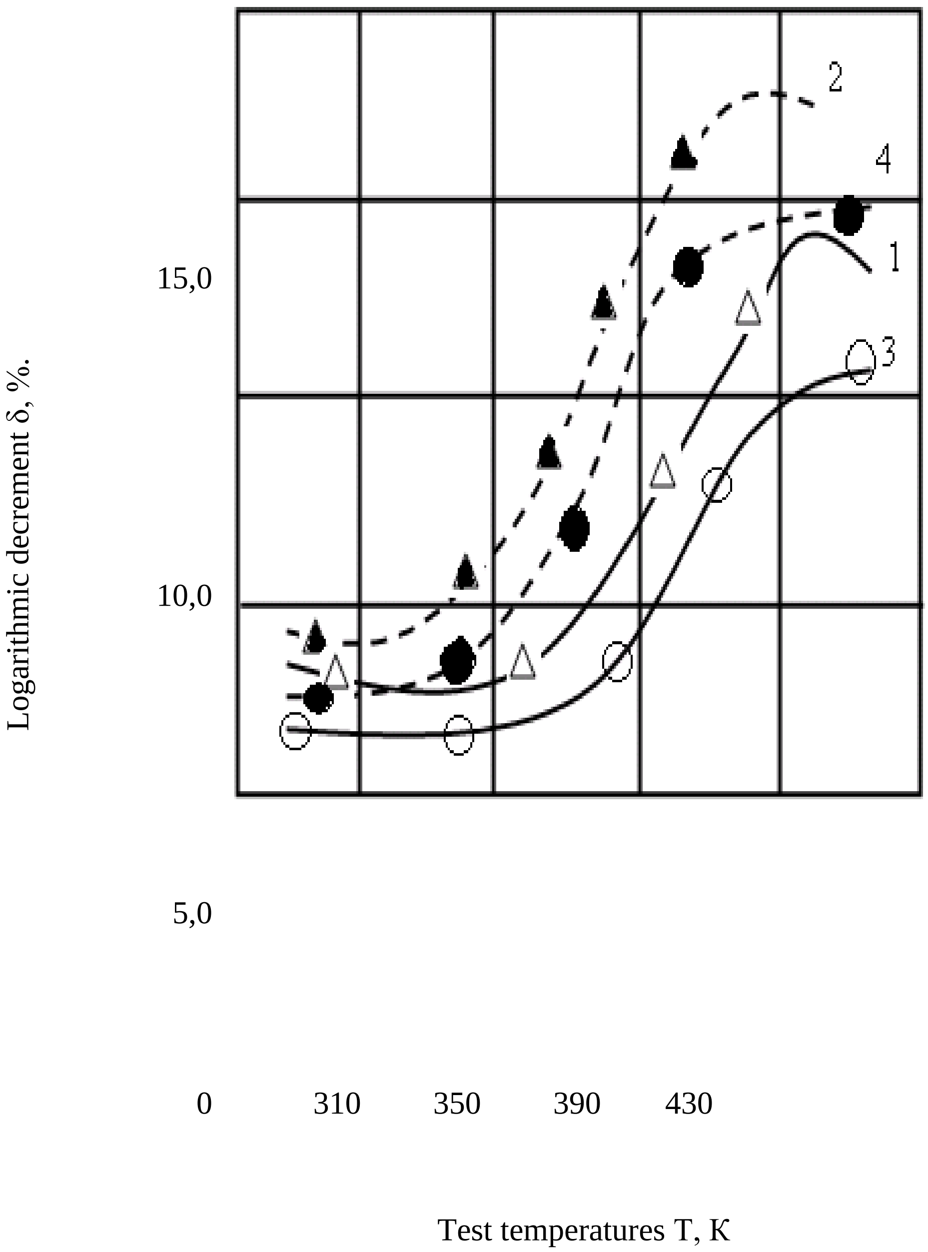
Table

Dependence of the logarithmic decrement of vibrations of unidirectional hybrid composite materials based on the binder EDT-10 and fibers of different modulus with different discreteness on the level of relative deformation

Type and content of reinforcing fibers in the volume of GCM filler, %				Level of relative deformation, Eo 10^4				
				2,5	5,0	7,5	10,0	12,5
low modulus		Highly modular		Logarithmic decrement of fluctuations, %				
Glass IMPS, continuous	80	Carbon УКН-300, l_a=20мм	20	2,8	3,5	3,8	4,4	5,2
	65		35	3,0	3,8	4,6	5,2	5,5
	50		50	2,9	3,2	3,7	4,1	4,7
Organic CBM, continuous	80	Carbon УКН-300, l_a=20мм	20	2,1	2,4	2,9	3,6	3,9
	65		35	2,3	2,7	3,0	3,3	3,7
	50		50	2,5	3,1	3,9	4,7	5,1

In organocarbon fiber-based plastics CBM(ТУ 6-06-31-82-75) and УКН – 300(ТУ 6-06-31-282-80) an increase in the amplitude dependence of the logarithmic decrement of oscillations when creating discreteness of high-modulus fibers is significantly manifested at a higher content of carbon discrete fibers in the volume of the filler. So, in organocarbon fiber with a 50% content of carbon fibers in the volume of the filler, with an increase in the level of relative deformation by 5 times in a composite with l_a/l_p=1,0 (l_a- discrete fiber length, l_p- length of the working part of the sample, l_p=20 мм) logarithmically, the oscillation decrement increases by 1.5 times, and when l_a/l_p=0,25 (l_p=80 мм) the value of the logarithmic decrement of oscillations increases by more than 2 times.

The figure shows the temperature dependences of the logarithmic decrement of vibrations under bending loading of unidirectional glass-carbon plastics and organo-carbon plastics based on continuous low-modulus and high-modulus carbon fibers with different discreteness.



Rice. Dependence of the logarithmic decrement of oscillations of unidirectional hybrid composite materials based on the binder ED-16 and a system of multi-modulus fibers with different discreteness on the test temperature: la/lp=1,0; 2- fiberglass based on continuous fibers VMPS (65%) and fibers UKN - 300 (35%) with discreteness la/lp=0.25; 3 - organocarbon-plastic based on continuous SVM fibers (50%) and UKN-300 fibers (50%) with a resolution of la/lp=1.0; 4- organocarbon fiber based on continuous SVM fibers (50%) and UKN-300 fibers (50%) with a resolution of la/lp=0.25.

As can be seen from the figures, when creating the discreteness of a high-modulus carbon filler in hybrid composites, along with an increase in the logarithmic decrement of vibrations in the region of normal temperatures, an increase in the height of the peak of mechanical losses in the region of the glass transition temperature of the binder is observed. In addition, for hybrid composites containing a discrete high-modulus phase, an increase in the slope of the curves of the temperature dependence of the logarithmic decrement and an expansion of the temperature region of the relaxation peak of mechanical losses are observed.

This is apparently due to an increase in the viscoelasticity of composite materials and their deformability with an increase in the degree of discreteness of a high-modulus rigid carbon filler, as well as an increase in mechanical losses in materials due to shear stresses arising at the end sections of high-modulus discrete fibers under cyclic loading, with an increase in the degree of discreteness of high-modulus carbon fillers. fibers in unidirectional hybrid composites, the properties of the polymer matrix, less heat-resistant low-modulus fibers, begin to manifest themselves to a greater extent in the region of elevated temperatures. The creation of discreteness of high-modulus carbon fibers leads to a decrease in thermal stresses in fiberglass at elevated temperatures, due to the difference in the coefficients of linear thermal expansion of the reinforcing fillers.

Such fibers are cotton fluffs (l=0.5 - 2 mm) and linters (l=1-5 mm), as well as waste from alkali processing facilities (l=5 - 30 mm). With the use of these discrete fibrous fillers, it is possible to reduce the content of the main continuous glass and carbon fibers, thereby not only reducing the cost of reinforced epoxy and furanoepoxy composite materials, but also reducing their own entire manufactured products from them due to the low density of such GCMs.

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