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UDC 678.549

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OPTIMIZATION OF THE MODE OF THERMAL TREATMENT OF BIOCOMPOSITES FILLED WITH COFFEE GROUNDS

The problem of increasing environmental safety is caused by an increase in environmental pollution. This problem forces scientists to focus on the development of biocomposites based on biodegradable polymers containing fillers of natural origin. The practical use of biodegradable polymers, such as polylactide or thermoplastic starch, is limited due to the technologically complex process of their production and processing, which leads to an increase in the cost of products. Therefore, natural fillers are widely used allow reducing the consumption of polymeric materials [1].

A promising raw material for filling biocomposites is the use of by-products of agro-industrial production and waste of plant origin, in particular coconut shells, coffee grounds and tea leaves after use [2], as well as various types of fibers (linen, bamboo, cotton, hemp, etc.) [3, 4].

In order to reduce the duration of heat treatment, the modes of heat treatment of biocomposites containing coffee grounds in the amount of 190 parts by weight and 200 parts by weight have been developed (Table 1). The preliminary degree of drying of the composition is 20%. Thermal treatment of biocomposites was carried out at a temperature of 150°C. It is necessary to carry out additional pressing of the composition during heat treatment. After heat treatment, the biocomposite samples are cooled in a press form in still air at room temperature.

Table 1. Mode of heat treatment of biocomposites

Content of coffee grounds, parts by weight	Mode of heat treatment			
	№ 1	№ 2	№ 3	№ 4
190	1 hour 150 °C	1 hour 150 °C	30 minutes	30 minutes
200	+ 1 hour 150 °C	+ 30 minutes 150 °C	150 °C + 1 год 150 °C	150 °C + 30 minutes 150 °C

Biocomposites formed according to mode No. 1 and containing 190 parts by weight of filler have the highest compressive strength of 79.6 MPa. The compressive strength of biocomposites (73.2 MPa) decreases by 9% with an increase in the filler content to 200 parts by weight. The compressive strength of biocomposites formed according to heat treatment mode No. 2 decreases by 27-32% compared to samples that have the maximum value of this characteristic. Compressive strength of biocomposites with a content of 190 parts by weight of coffee grounds is 62.5 MPa, and with a filler content of 200 parts by weight – 60.5 MPa.

Compressive strength of biocomposites with a content of 190-200 parts by weight of filler formed by mode No. 3 decreases by 35-52% compared to biocomposites formed by mode No. 1 and by 6-19% compared to biocomposites formed by mode No. 2. Compressive strength of biocomposites (filler content 190 parts by weight) is 58.9 MPa. Compressive strength of a biocomposite with a coffee grounds content of 200 parts by weight is 52.5 MPa.

The lowest values of compressive strength were obtained for biocomposites formed by mode No. 4. Compressive strength of biocomposites containing 190 parts by weight of filler is 50.9 MPa, and biocomposites containing 200 parts by weight part of the filler - 47.8 MPa. These values are lower by 56-67% compared to the compressive strength values obtained for the biocomposites formed by mode No. 1.

An increase the duration of heat treatment leads to an increase in compressive strength, since treatment in a thermal field at a temperature of 150 °C ensures the melting of the biopolymer binder, resulting in sufficient wetting of the surface of the filler particles. This causes an increase in the packing density of the components of the biocomposite material and the formation of a significantly larger number of physical and chemical bonds.

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