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COMPOSITE MATERIALS REINFORCED WITH BRAIDED PREFORMS

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Abstract. *An experimental study of the bending strength of composite materials created using two layers of braided preforms made of glass and flax fibers was carried out.*

Composite materials are widely used in the automotive and aviation industry [1], the production of sports equipment [2], construction [3], etc. Composite materials are characterized by high relative strength, flexibility and low weight. Different requirements apply to the physical and mechanical properties of composite materials depending on their purpose compared to conventional isotropic materials. In this research alternative natural fibers and thermoset matrices have been taken into account. While natural fibers are degradable, thus, nature friendly, most synthetic and inorganic fibers such as carbon and glass fibers as well as most matrices are not.

Currently, manufacturers of sports equipment have noted an increased consumer interest in eco-friendly (bio-based) products. This stimulates the production of composite materials from natural fibers, primarily using flax fibers [4, 5, 6, 7]. Natural fibers have often insufficient characteristics than conventional reinforcement fibers in terms of strength characteristics, but in many cases they are able to satisfy the requirements imposed on the physical and mechanical properties of composite materials. Furthermore, from the point of view of the consumer it is often important to see unique visual effects on the surface of the composite material.

Sophisticated technical products that use composite materials in their structure can have a wide variety of forms, depending on their purpose, which may require the creation of various three-dimensional surfaces. For example, radial braiding machines can be used to create preforms repeating various cylindrical, tapered, and curved surfaces [8, 9].

In the framework of this work, braided preforms of four types were used. The preforms were manufactured using combination of flax and glass fibers with different ratio of the number of fibers.

Of practical interest is a comparative analysis of the strength characteristics of composite materials obtained using both natural flax and inorganic glass fibers. In this study bending characteristics of composite materials created on the basis of braided preforms formed on the radial braiding machine Herzog RF 1 / 64-120 from flax and glass fibers were determined and analyzed. The linear density of the used fibers is 8 tex. Since the layer thickness of the composite material is important for sports equipment, in this study a two-layer structure was formed. This allowed to limit the thickness of the composite material to 2 mm. Determination of mechanical characteristics was performed using the universal testing complex Zwick 1455 using the three-point-bending method [10]. The test is conducted by bending of a flat rectangular sample freely lying on two supports and loaded at a constant speed until the moment of destruction. The size of the used samples is 15 mm × 60 mm × 2 mm. Composite material was formed using the method of vacuum infusion using two different bio-based epoxy systems. These are the Sicomin system, with SR InfuGreen 810 epoxy resin and SD 8824 hardener, and SUPER SAP systems with INR epoxy resin and INS0 hardener.

Figure 1 shows the results of the bending tests for samples of a composite material formed using four types of braided preforms and the Sicomin SR InfuGreen 810 + SD 8824 epoxy system.

Analysis of experimental data showed that the samples formed using preforms consisting entirely of glass fibers have higher strength than the samples formed using preforms consisting entirely of flax fibers, while the samples formed using pure flax fiber preforms, destruction occurs at large values of bending. This is explained by the comparatively higher strength characteristics of glass fibers and the large tensile elongation of flax fibers.

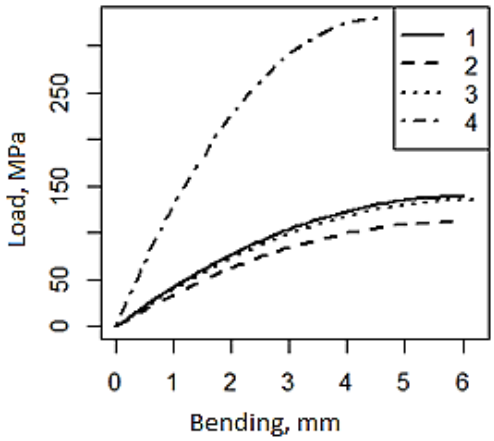

Figure 1 – Deformation of composite materials
1) pure flax fiber preform; 2) 75 % flax fiber, 25 % glass fiber;
3) 50 % flax fiber, 50 % glass fiber; 4) pure glass fiber preform

Conclusions

An experimental study of the bending strength of composite materials created using two layers of braided preforms made of glass and flax fibers was carried out. In this study statistically significant models that describe the process of the bending of the studied samples of composite materials have also been developed.

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