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CARBON HONEYCOMB PLASTIC AS LIGHT-WEIGHT AND DURABLE STRUCTURAL MATERIAL

Abstract

Honeycomb structures (HS) are widely known and used in products where high strength and low weight are critical.

It is particularly important for products meant for aviation and space.

The main tendency for modern development of the given direction consists in creation of extra-strong and dimensionally stable HS based on carbon fibers.

Honeycomb filler (HF) on the basis of carbon reinforcement, that is, carbon honeycomb plastic (CHP):

- has maximum absolute and specific indices of compression/shear strength and stiffness;
- possesses minimum coefficient of linear expansion;
- in combination with carbon-fiber reinforced plastic skins, allows to create chemically uniform dimensionally stable structures, which enjoy wide application in aerospace engineering (reflectors, antennas).

With a view to optimizing operational characteristics of carbon-fiber HF, various reinforcement patterns were considered.

The results for strength and shear modulus have shown their dependence on the reinforcement pattern and height of the filler.

Assessment of the effect of various patterns of the reinforcing agent onto shear modulus and determination of the rational reinforcement pattern is possible with the use of finite element method (FEM).

The unitized method is taken as a basis for development of CHP manufacturing technology. Elementary blanks with the chosen reinforcement pattern were formed of carbon prepreg, and corrugated by means of the punch.

Corrugated blanks were assembled into one unit. Honeycomb unit thus assembled was subjected to heat treatment, cut on the perimeter and grinded in accord with the dimension specified by height.

A series of samples was made of CHP blank to perform the shear modulus and strength tests in parallel and perpendicular directions of adhesive bands.

Found that the highest physical-mechanical characteristics (PhMC) were obtained at reinforcement pattern [45°].

Anisotropic properties of HF on the basis of carbon fibers are less pronounced than those of HF made of aluminum foil.

Carbon honeycomb plastic with cell face of 5 mm -5,0 was obtained with volume weight of:

- 85,0 kg/cub.m of expanded carbon fiber -36S-12 impregnated with binder, with monolayer of 80-90 mcm thick, and reinforcement pattern [45°];

- 127,8 kg/cub.m of carbon tape -- with monolayer of 130 mcm thick, impregnated with binder, reinforcement pattern [45°];

- 41,0 kg/cub.m of carbon yarn IMS 65, impregnated with binder, with monolayer of 20 mcm thick, reinforcement pattern [45°].

CHP PhMC can be regulated due to using the thinner carbon reinforcement agents, changing cell face dimensions and reinforcement patterns.