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A.V. Karpenko, Ph.D
Zaporizhzhya National University, Ukraine

FEATURES OF FORMING THE STRUCTURE AND PROPERTIES OF HIGH-POROUS CARBON-CARBON COMPOSITE MATERIALS

Carbon-carbon composite materials (CCCM) are increasingly used in aviation (for example, friction elements of aircraft brake systems, antifriction elements of aircraft engines); aerospace engineering (heat-insulating materials for protecting heat-loaded units of machines and assemblies operating in vacuum, inert or reducing environments at temperatures up to 25000C, in an oxidizing environment up to 4000C, etc.), in the semiconductor industry (heating units and thermal insulation of electrovacuum furnaces, instead of graphite and refractory metals), etc.

Thermal insulation protection for the temperature range of 2000º-3500ºC, exceeding the operating temperature of most ordinary high-temperature thermal insulation, based on oxides, Me and other heat-resistant materials involves the development of new heat-insulating alloys and compositions having the necessary mechanical properties at these temperatures. Highly porous CCMs meet these requirements. The thermal insulation properties of these materials are determined mainly by their highly porous structure. For the production of CCCM, the starting materials are blanks obtained by pressing, “dry” and “wet” winding methods, and spills from aqueous suspensions.

Classical methods of pressing and winding are well known and are widespread.

Spill forming of blanks from aqueous suspensions is usually used in the manufacture of composites reinforced with short fibers. Coal tar pitch or phenol-formaldehyde resins are very often used as matrices, and usually with such a technology the dimensions of products can be especially large.

Since the fibers have a finite length, the degree of reinforcement of the material is relatively low and the fibers are randomly oriented. As a result of this, such composites cannot be classified as high-strength materials. However, these materials are widely used to obtain a large number of parts in which a low degree of reinforcement and arbitrary orientation of the filler does not interfere with obtaining the required mechanical characteristics.

The general scheme for the preparation of a preform and the production of low-density material includes the following steps: preparation of a filler and a binder; mixing with water; deposition of the work piece; curing of carbon fiber (carbonization); carbonization of the work piece; high temperature treatment; manufacture of parts of the required shape

An aqueous suspension is formed from phenol-formaldehyde resin powder and chopped carbon fibers. With active mixing in a volume of liquid with a low concentration of components, the spread in particle sizes does not significantly affect the distribution.

Directly on the filter sieve and in the zone of extremely high particle concentrations there are processes of formation of the preform structure (which are determined by the rate of fluid filtration through the filter and the mass of particles). With the inclusion of a vacuum pump, a pressure difference appears above and below the suspension layer, which is the main driving force for fluid flow.

Carbonization ensures the destruction of the phenol-formaldehyde resin and its transition into a solid carbon matrix (coke). At this stage of the technology, volatile pyrolysis products are released, closed and open porosity is formed, and the workpiece shrinks.

Obtained according to the above technology, the material is a rigid carbon-carbon composition of carbon fibers and a matrix of the coke residue of a phenol-formaldehyde resin. The resulting material is characterized by good thermal insulation properties, while its density is 0,2-0,25 $\cdot 10^3$ kg/m^3, open porosity reaches 70%, the compressive strength is in the range of 40-80 MPa.