COMPOSITION AND PROPERTIES OF COMPOSITE ELASTOMER MATERIALS

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Abstract
Composite elastomer materials combine a large group of composite materials that can easily deform under the action of small loads and restore their shape after very significant deformations. When stretched, they retain their elastic properties under deformations, usually not exceeding 1%. The elastomeric composition, on the other hand, is capable of withstanding repeated stretching by 500-1000% without destruction, without noticeable residual deformation. Due to these properties, elastomeric compositions are called highly elastic. When stretching a steel bar twice, a force of about 105 MPa would be required, and for stretching a composition based on various rubbers from 5 to 10.0 MPa. Their wide application is determined, in addition, by a number of its other specific features.

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As is known of numerous products based on composite elastomeric materials, the largest volume falls on conveyor belts, drive belts, sleeves, complex machine parts made of rubber or rubber with metals and textile materials, rubberized technical fabrics and products made from them, brake shoes, etc.

Elastomeric compositions used for the manufacture of products are subject to a certain set of requirements in accordance with specific operating conditions. The range of required properties is very wide - mechanical strength, rigidity, elasticity, resistance at high or low temperatures, resistance to the action of various aggressive substances, electrical insulating properties or electrical conductivity, color, non-toxicity, etc. tasks of creating composite elastomeric materials with the desired set of properties.

To obtain composite elastomeric materials, high-molecular polymers with a low transition temperature from a glassy or solid crystalline state to a highly elastic state are used - elastomers. In addition to elastomers, various ingredients are used in the manufacture of rubber products, which are necessary both for chemical transformations of rubbers in the processes of their processing, and for imparting certain properties to rubber products.

According to their action, the ingredients are divided into vulcanizing agents, vulcanization accelerators and activators, fillers, plasticizers, antioxidants, etc. They belong to various classes of chemical compounds of a very complex structure; their content varies from fractions to tens of percent of the binder content. To
improve the physical and mechanical properties of elastomeric compositions - wear resistance, strength, hardness, and a number of others - large amounts of various finely dispersed mineral fillers and technical carbons are used.

Vulcanizing agents are chemically active compounds that take part in the formation of the spatial structure of vulcanizates. In the process of formation of a spatial structure, with an increase in the degree of cross-linking, there is a decrease in the number average (Ms) segments of polymer chains and, accordingly, an increase in the number of cross-links per unit volume of the vulcanizate (ν).

With a change in the degree of cross-linking, a gradual change in the properties of vulcanizates occurs. The equilibrium modulus with increasing density of the vulcanization network and in accordance with the molecular-kinetic theory of elasticity increases in direct proportion to the number of cross-links or inversely proportional to the average molecular weight of the chain segments between the nodes of the spatial network of the vulcanizate.

The change in hardness and strength characteristics of vulcanizates depends on many factors. So, when vulcanizing rubbers with sulfur, depending on the content of added sulfur, and hence on the density of the vulcanization network, first up to the content of bound sulfur of about 5 wt. h. there is an increase in tensile strength of vulcanizates. Such a vulcanize has the properties of soft rubber. With a further increase in the content of bound sulfur up to 10 mass.h. the strength of vulcanizates decreases, the material becomes hard, leather-like. If the content of bound sulfur is further increased, then the strength of the vulcanizate increases again, and it will turn into hard ebonite. This is explained by the fact that when a certain degree of crosslinking is reached, the distance between some nodes becomes too small as a result of uneven crosslinking, which makes it difficult to orient the molecular chains during stretching. This leads to local overvoltages, therefore, to breaking the circuits in these places. A further increase in the strength of the bond with the transition from highly elastic to elastic deformation, and the strength in this case will be due to purely chemical bonds.

Vulcanizing agents into the compositions. In this case, the number of cross-links formed will depend on the nature of the rubber, the nature and content of the vulcanizing agent, and the vulcanization conditions.

Some accelerators are also vulcanizing agents. For example, thiarums and polysulfide accelerators at curing temperatures can cure some rubbers without the use of elemental sulfur. The activity of most accelerators increases with the introduction of metal oxides, stearic acid, etc.

Vulcanization accelerators for one type of rubber may completely lose the properties of accelerators and play a different role in compositions based on another rubber. For example, disulfide, being a vulcanization accelerator for natural and styrene-butadiene rubbers, serves as a scorch retarder and plasticizer for narrate.

REFERENCES


