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USING VARIOUS ACCELERATOR SYSTEMS, IT IS POSSIBLE TO INFLUENCE THE PROPERTIES OF

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ANNOTATION

An increase in the proportion of intermolecular and a decrease in the proportion of intra-molecular bonds. The main ingredients of elastomeric compositions are fillers, their purpose is to change the volume and properties of the composition and quality indicators in the right direction. Achieving this goal is primarily related to the nature of the combination of elastomer and filler, as well as the nature of their interaction.

Keywords: intermolecular, ingredients, elastomeric composition, elastomer, temperature, chemistry, oils, acids, deformation.

Rubber products used in mechanical engineering are made from rubber compounds consisting of various components, which the main ones include:

elastomers-natural and synthetic, such as isoprene, styrene butadiene, chloroprene, nitrile rubbers, widely used in the manufacture of tires and rubber products;

fillers-mineral and organic such as carbon black (soot), chalk, kaolin and other materials that increase the strength and wear resistance of rubber;

plasticizers-oils and other substances that improve the ductility and processing of rubber compounds;

Vulcanizing agents-sulfur as a vulcanizing agent, accelerators to eradicate the vulcanization process, metal oxides to activate the vulcanization process;

stabilizers and antioxidants are used to protect the product from external aggressive processes.

The production process of rubber compounds consists in the mechanical mixing of rubbers and ingredients on special equipment, such as mixing rollers or rubber mixers of a closed type.

In addition, materials such as polyethylene terephthalate (PET) are used to reinforce rubber products, which enhances the mechanical and physical properties of products. Thus, rubber products play a key role in various industries, the combination of these components provides the necessary properties of rubber products for their effective use in mechanical engineering, railway and aviation equipment.

Very high technical requirements are imposed on rubber and rubber products. Serial rubbers based on natural and synthetic (SKI-3, SKD, SCS) rubbers do not meet these requirements. The development of technology has necessitated the creation of special rubbers with high oil, frost and fire resistance, indifference to various chemical agents, mechanical strength and other properties, as well as the manufacture of rubber products resistant to sudden changes in temperature and humidity, capable of operating in an environment with a high ozone content. Special rubber products are rubber products designed to perform specific functions in various industries. Their technical characteristics depend on the purpose, operating conditions and materials used.

Due to further technological progress, the requirements for the properties and quality of special rubbers are increasing, and in some cases it becomes necessary to give special properties to rubbers. Obtaining special rubber products includes several key stages of technology, depending on the type of product (seals, belts, hoses, gaskets, etc.).

Special rubber products (SRTI) are products made of rubber or rubber–woven materials and designed to work under special operating conditions. Such products include, for example, reinforced hoses, sealing elements for aggressive media, vibration-proofing and shock-absorbing components, as well as products operating at extreme temperatures or under high pressure.

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The basis of rubber products are elastomers, which can be natural or synthetic (butyl rubber, silicone rubbers, fluoro rubbers, etc.), The introduction of fillers (soot, silica), plasticizers, vulcanizing agents (sulfur, peroxides) allows you to regulate the mechanical and operational properties.

To give rubber products used in modern engineering, railway and aviation equipment the required properties, rubbers are mixed with organic or inorganic, bulk or liquid substances and then subjected to vulcanization. Most of the ingredients change the properties of not only vulcanizates, but also rubber compounds and thus affect their behavior in production processes.

Vulcanizing agents are chemically active compounds involved in the formation of spatial structure during the vulcanization of rubber compounds. During the formation of the spatial structure, with an increase in the degree of crosslinking, 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 vulcanizer (□).

With a change in the degree of cross-linking during vulcanization, a gradual change in the properties of the vulcanizer occurs in rubber compounds. The equilibrium modulus increases with increasing density of the vulcanization mesh 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 vulcanizate mesh.

The change in hardness and strength characteristics of vulcanizates depends on many factors. Thus, during the vulcanization of sulfur rubbers, depending on the content of the attached sulfur, and hence on the density of the vulcanization mesh, first up to the content of bound sulfur about

5 wt.h. there is an increase in the tensile strength of vulcanizates. Such vulcanizate has the properties of soft rubber. With a further increase in the content of bound sulfur to 10 wt.h. the strength of vulcanizates decreases, the material becomes rigid, leathery. If the content of bound sulfur is further increased, the strength of the vulcanizate increases again, and it will turn into solid ebonite. This is because when a certain degree of crosslinking is achieved, the distance between some nodes becomes too small as a result of uneven crosslinking, which makes it difficult to orient the molecular chains when stretched. This leads to local overvoltages, therefore, to the rupture of circuits in these places. A further increase in bond strength is associated with the transition from highly elastic to elastic deformation, and the strength in this case will be due to purely chemical bonds .

As the density of the vulcanization mesh increases, the relative and residual elongations decrease to very small values typical of brittle materials. At the same time, elasticity varies according to a complex dependence, the maximum elastic properties are manifested with such a density of the vulcanization mesh, at which maximum strength is observed for soft rubbers. In addition, swelling in solvents decreases in proportion to an increase in the degree of crosslinking.

To obtain rubbers with a given set of properties, it is necessary to ensure a certain degree of cross-linking of elastomers by introducing a certain amount of vulcanizing substances into the composition. The number of cross-links formed will depend on the nature of the rubber, the nature and content of the vulcanizing agent, and the conditions of vulcanization.

Some accelerators are also vulcanizing substances. For example, tiaras and poly sulfide accelerators at the vulcanization temperature can vulcanize 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, dibenzthiazolyl disulfide, being an accelerator of vulcanization of natural and styrene butadiene rubbers, serves as a retarder under vulcanization and a plasticizer for narite.

The use of organic accelerators has made the most significant changes in the process of rubber vulcanization. They significantly improve the technical properties of vulcanizates, increase the resistance of rubber products to aging, create the possibility of obtaining homogeneous massive products, shorten the duration of vulcanization, as a result of which the number of equipment and energy consumption are reduced several times, and labor productivity increases. Many accelerators are mutually activated during vulcanization. Using various accelerator systems, it is possible to influence the properties of vulcanizates, change the “rubber-stretching” curve, increase stress at a certain elongation and strength properties even in the absence of reinforcing fillers. Organic accelerators exhibit an active effect during vulcanization in the presence of certain metal oxides and hydroxides. Metal oxides have the most effective effect in the presence of fatty acids such as stearins, palmitic acid, oleic acid, etc.

The nature of the activators depends on the type of rubber, the accelerators used, the fillers and the vulcanization temperature. The effect of activators on the structure of vulcanizates and, accordingly, on the physical, mechanical and operational properties of vulcanizates is diverse. In the presence of zinc oxide, zinc salts of accelerators and zinc sulfide are always formed during vulcanization of the rubber compound. The resulting vulcanizates are characterized by higher physical and mechanical strength, tear resistance and dynamic endurance, while the rate of sulfur addition increases slightly. It has been found that in the presence of activators, the concentration of cross-links increases with the same amount of bound sulfur. This indicates an increase in the proportion of intermolecular bonds and a decrease in the proportion of intra - molecular bonds . The main ingredients of elastomeric compositions are fillers, their purpose is to change the volume and properties of the composition and quality indicators in the right direction. Achieving this goal is primarily related to the nature of the combination of elastomer and filler, as well as the nature of their interaction.

It has been established that the limitation of the mobility of elastomer chains as a result of its interaction with the filler is more noticeable the more the surface of the latter is developed. The reinforcing ability of the filler is significantly influenced by its properties such as dispersion, agglomeration and the chemical nature of the surface. With an increase in the dispersion of the filler and the wettability between its surface and the elastomer macromolecules, the overall limiting effect of the filler on the reinforcement of the elastomeric composition increases. The type of filler and its content in composite elastomeric materials are selected taking into account the overall effect of the filler on its physical properties.

The choice of filler is determined primarily by the size of its particles and their size distribution, as well as the shape of the particles and the nature of their packaging. The division of particles into classes is quite arbitrary and is based on the difference in the surface area of the particles. This classification takes into account two main characteristics of dispersed fillers - particle size and surface area, which can be realistically measured and therefore serve as the basis for the systematization of fillers for their intended purpose. The size of the filler particles is crucial in reinforcement, provided that other factors affecting reinforcement, such as the surface tension at the rubber-filler interface, the shape of the filler particles, and the distribution of filler particles in the composition, remain constant. The particle shapes of most fillers vary enormously and cannot be strictly characterized. Therefore, only particle sizes and their surface area can serve as a basis for classifying fillers and assessing their effect on the properties of polymer-filler systems.

Fillers of polymer mixtures are usually rather fine powders, which allows for a fairly uniform distribution of filler particles in the polymer. At the same time, the full use of the filler surface is possible only if each particle of the filler is surrounded by a rubber film. The dispersion of the filler depends not only on its tendency to agglomeration and flocculation, but also on the surface activity (lubricity) at the polymer-filler interface. The energy used in the dispersion of soot is spent mainly on overcoming the interaction between particles or primary aggregates. The interaction between particles or primary aggregates is greater in dispersed carbon black, because with a decrease in particle size, the number of active sites and oxygen-containing groups located on their surface increases.

Despite the increased energy consumption, non-dispersed filler particles are no longer found in mixtures containing dispersed fillers. At the same time, in mixtures where the filler has larger particles, a smaller number of non-dispersed particles are found. This is due to the fact that highly dispersed carbon black, having significant free energy, is capable of forming strong agglomerates. In addition, with an increase in the dispersion of soot, its specific surface area increases, which must be moistened with rubber.

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