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RAW MATERIALS IN THE AUTOMOTIVE TIRE MANUFACTURING INDUSTRY

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Abstract: The vulcanization process is a crucial technological procedure for reinforcing rubber materials and improving their physical properties. Through this process, the elasticity, durability, and long-term performance characteristics of rubber materials are enhanced. Various chemicals, including vulcanizing agents, accelerators, activators, plasticizers, post-vulcanization retarders, and abrasion-resistant substances, are used to improve the effectiveness and quality of the vulcanization process. Sulfur is used as the main vulcanizing agent, which ensures the cross-linking of rubber chains, thereby increasing the material's strength.

Keywords: Vulcanization process, rubber materials, elasticity, durability, performance characteristics, chemicals, vulcanizing agents, accelerators, activators, plasticizers, post-vulcanization retarders, abrasion-resistant substances

Introduction: A range of rubber compounds are used for tire production, depending on the required characteristics of the automobile tire. When selecting the components of rubber compounds, it is crucial that they remain stable during storage and possess good technological properties. Additionally, attention should be given to their toxicological and economic characteristics [1].

SKI-3 Isoprene Rubber: This rubber is similar to natural rubber in its properties but is significantly cheaper in terms of cost. Its crystallization temperature is -25º C, and the crystallization rate is approximately 20 hours. The density is 910-930 kg/m³. The formation of crystalline structures at 20°C ranges between 300-400%. Mixtures based on this rubber blend well, produce low heat, and form well. Due to its high susceptibility to destruction during processing, strict adherence to temperature regimes is necessary. The plasticity of SKI-3 and the heat resistance of its vulcanizates are higher compared to TK. However, SKI-3 has several drawbacks, such as lower strength, tear resistance, adhesion, and lower strength when the mixture is raw compared to other rubbers [2].

Main Part: SKMS-30-ARK - Butadiene-Methyl-Styrene Rubber. This rubber is widely used in the production of rubber products, as it has good reprocessability with conventional equipment. When active fillers are added to mixtures based on this rubber, they demonstrate high mechanical strength and good wear resistance. However, SKMS-30 lags behind SKI-3 in terms of vulcanizates and elasticity. SKD - Synthetic Stereoregular Butadiene Rubber**.** The crystallization temperature is 50-60°C, and the density is 900-920 kg/m³. At normal temperatures, the rubber is amorphous, but it hardens during the crystallization process. The rubber has a low molecular mass distribution (MMT), low cohesive strength, and poor adhesion to metals, which are part of

its technical requirements. Each ingredient in a compound contributes specific properties, and they are used in precise amounts Sulfur, a yellow crystalline substance with a density of 2070 kg/m³ and a melting point of -112.8°C, is used as the vulcanizing agent[3]. It ensures the cross-linking of rubber chains. Vulcanization Accelerators. To enhance the reactivity of sulfur, accelerators such as thiazoles (2MBS), sulfenamides S, and sulfenamide M are used. These accelerators improve the technological properties of vulcanizates and increase wear resistance. Thiazole 2MBS (altaks): A light yellow powder with a faint odor, the boiling point is 186°C, and the density is 1500 kg/m³. It disperses well in mixtures but is inactive at temperatures of 100-130°C, making it rarely used for post-vulcanization. It provides vulcanizates with a low modulus and positive wear resistance.Sulfenamide S. Granules with a bright green color, density 1270-1300 kg/m³, and boiling point of -130°C. Its presence in the mixture results in an induction period in the vulcanization process, followed by significantly high performance during the main phase. It accelerates the vulcanization optimum. Sulfenamide M. A bright yellow crystalline compound with a boiling temperature of 80°C and density of 1340 kg/m³. Mixtures based on this accelerator rarely undergo premature vulcanization [4].

Post-Vulcanization Retarders. Post-vulcanization retarders are used to prevent premature vulcanization. These additives ensure that the vulcanization process occurs within the required time frame. Abrasion-Resistant Additives. To prevent premature wear of the rubber, abrasion-resistant agents such as deafen FP, acetoneanil P, and Omsk-10M protective waxes are added to the compound. Plasticizers. To increase the plasticity and high elastic state of the polymers, the following plasticizers are used: industrial oils, petroleum bitumen, and rosin. One of the effective methods of modifying polymer material properties is the use of fillers, which results in substances evenly distributed throughout the mixture. The use of fillers improves the physical-mechanical and technological properties of rubber while also reducing its cost. Fillers. Technical Carbon P245, P514: These are carbon-based, low-dispersed powdered substances, obtained by compressing natural gas in special furnaces. These are black substances and are considered reinforcing fillers for rubber mixtures. Under their influence, the strength, wear resistance, and crack resistance of rubber increase. The density of P514 is 1860 kg/m³, while P245 has a density of 1400 kg/m³ [5].

Kaolin is a white powder with a density of 2600-2670 kg/m³. Its particles have an elongated shape. It enhances the oil resistance of rubber.RU 1 Modifier. The RU 1 modifier is a complex compound made from boric acid, resorcinol, and urotropine. It is in granular form, with a decomposition temperature of 130°C. This modifier stands out for its high dispersibility and its ability to evenly distribute in rubber mixtures. It improves the strength of vulcanizates under various deformations and enhances the bonding of rubber cord systems under static and dynamic conditions.

- **Natural Rubber**
- **SKI-3** (Isoprene rubber)
- **SKD** (Synthetic stereoregular butadiene rubber)
- **Sulfur**

- **Thiazole 2MBS** (Accelerator)
- **Zinc Oxide (ZnO)**
- **Technical Stearin**
- **Benzoyl Acid**
- **RU-1 Modifier** (Resorcinol and urotropine complex)
- **Deafen FP** (Anti-abrasion agent)
- **DBS** (Dibutyl Sebacate Plasticizer)
- **Industrial Oil**
- **Technical Carbon (Black)** - P514, P245
- **Paraffin**[6].

Conclusion: The vulcanization process is a necessary technological procedure for improving the quality of rubber materials and extending their service life. The proper selection and combination of chemical substances such as sulfur, accelerators, activators, plasticizers, scorch retarders, and anti-wear agents enhance the strength, elasticity, and durability of rubber. Each substance used in the vulcanization process serves a specific function, perfecting the technological properties of the material. With the help of these substances, the vulcanization process becomes more efficient, ensuring the quality and long-term performance of rubber products. This, in turn, helps meet the demand for high-quality rubber materials in the automotive industry and other sectors.

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