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# The influence of copolymers of ethylene and vinyl acetate on the thermo-and aggressiveness of plantar rubber

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**Abstract**

In the present article, a rubber mixture for the soles of oil and petrol resistant footwear based on butadiene-nitrile and methylstyrene rubbers is investigated. It is known that in conditions of active contact with petroleum products, with frequent dynamic deformations, deformations of bends and shifts, rubber products lose their initial operational characteristics. To increase the resistance to aggressive environments, wear resistance and durability of rubber products, new technological additives are introduced into the rubber mixes. In particular, such additives can be copolymers of ethylene and vinyl acetate (SEVA). These copolymers have macromolecules of linear structure, do not contain unsaturated bonds, and are characterized by the presence of polar vinyl acetate groups. With a uniform distribution in the volume of the rubber, the SEVA are able to screen unsaturated bonds of caoutchouc molecules with their macromolecules, and also increase the strength of rubbers by forming coordination bonds between the oxygen atoms of the acetate groups and the carbon atoms of the nitrile groups of caoutchouc, and also the covalent bonds of the carbon atoms of the vinyl residues of SEVA with partially positive charged carbon atoms in the α-position with respect to unsaturated bonds or nitrile groups of rubber molecules. This helps to inhibit the aging process of rubbers, increasing their thermo-aggressive resistance and wear resistance, as well as dynamic endurance. In this connection, it is of interest to develop and investigate rubber with the use of SEVA as new technological additives that increase the wear resistance and thermo-resistance resistance of rubbers. This article has been studied the influence of different brands *SEVA 11104-030, 11808-390* and *EVA MarPol 1802* on rheometric, physical-mechanical and operational properties of rubber based on a combination of butadiene-nitrile caoutchouc BNKS-40AMN and styrene caoutchouc SKMS-30ARKM 15 with sulfuric and sulfenamide vulcanization systems. This rubber is used for making soles of oil and petrol resistant footwear. Rheometric properties were studied for the rubber mixture. For vulcanizates, physico-mechanical properties were determined (conditional tensile strength, relative elongation at break, Shore A hardness, tear and tear resistance), as well as resistance to thermal aging and weight change after aging in various media. As a result of the conducted studies, it has been established that vulcanizates of the rubber mixture 81-453 possessing the best physical-mechanical and operational properties contain SEVA 11808-390 and EVA MarPol 1802 as technological additives.

## References

[1] S.I. Sandalov, O.N. Feofanova, M.S. Reznikov, N.F. Ushmarin, D.O. Gnezdilov, N.I. Kol'tsov. Development of thermo-aggressive rubber on the basis of butadiene-nitrile caoutchoucs. *Bulletin of Kazan Technological University*. **2014**. Vol.17. No.3. P.108-110. (russian)
[2] N.I. Koltsov, N.F. Ushmarin, A.E. Petrov, N.P. Petrov, N.N. Petrov, and S.M. Verhunov. Research of influence of technological additives on properties of rubbers on the basis of BNR new generation. Part 3. Novantox 8 PFDA. *Butlerov Communications*. **2010**. Vol.21. No.10. P.22-28. ROI: jbc-02/10-21-9-22.
[3] N.I. Koltsov, N.F. Ushmarin, L.G. Rogozhina, S.A. Issakova, A.V. Jarutkina, A.Y. Plehanova, and M.V. Kuzmin. Research of influence of technological additives on properties of rubbers on the basis of BNR new generation. Part 4. Powder stabilizers on a basis novantox 8 PFDA. *Butlerov Communications*. **2010**. Vol.22. No.10. P.42-50. ROI: jbc-02/10-22-10-42

[4] R.M. Graif, N.I. Likhtarovich, L.N. Bochkareva. Rubber mixture. Patent 2200742 RU. Published 20.03.**2003**. (russian)
[5] M.V. Syayleva, A.M. Bukanov, K.A. Zvezdenkov, V.N. Voloshin, T.A. Merkulova. Modification of rubbers based on butadiene-nitrile rubber with copolymer of ethylene with vinyl acetate. *Rubber industry: raw materials, materials, technologies: Collection of works participants of the XXI scientific and practical conference*. Moscow: **2016**. P.71-72. (russian)
[6] N.F. Ushmarin, S.I. Sandalov, E.N. Egorov, N.I. Kol'tsov. Development and study of properties oil-swelling rubber. *Rubber industry: raw materials, materials, technologies: Collection of works participants in the XXII scientific and practical conference*. Moscow: **2017**. P.132-133. (russian)
[7] S.N. Rusanova, O.V. Stoyanov, N.E. Temnikova, V.I. Kimelblat, A.E. Chalykh, V.K. Gerasimov. Modification of polymers by organosilicon compounds. *Glues. Sealants. Technologies*. **2014**. No.12. P.13-25. (russian)
[8] N.E. Temnikova, A.E. Chalykh, V.K. Gerasimov, S.N. Rusanova, O.V. Stoyanov. Formation of the phase structure of polymer systems of copolymers of ethylene- [3- (2-aminoethylamine) propyl)] trimethoxysilane. *Glues. Sealants. Technologies*. **2016**. No.2. P.24-29. (russian)
[9] O.V. Stoyanov, S.N. Rusanova, R.M. Khuzakhanov, O.G. Petuhova, A.E. Chalykh, V.K. Gerasimov. Modification of industrial copolymers ethylene-vinyl acetate with limiting alkoxysilanes. *Bulletin of Kazan Technological University*. **2002**. No.1-2. P.143-147. (russian)