

# Investigation of the Properties of Compositions Based on Modified Polymer Mixtures

Shikhaliyev Kerem SEFI



**Abstract:** The properties of vulcanized compositions based on mechanical mixtures of Ethylene propylene rubber (EPR) and Ethylene propylene terpolymer (EPTR) with PVC deteriorate compared to the properties of EPR and EPTR peroxide vulcanizers, which is explained by the poor mixing of PVC with these copolymers. In the extruder of the specified polymer mixtures  $-145^{\circ}\text{C}$ , 36 MPa,  $n = 200$  g. The thermal and mechanical effects (MIC) under these conditions cause a significant improvement in the properties of the compositions based on these mixtures. The formation of EPR-PVC, and EPTR-PVX copolymers as a result of IMT in these polymer mixtures was confirmed by the construction of these copolymers with peroxide-free, PVC clusters with methemtal oxides - MgO, ZnO, and PbO (mass fraction 8-18). Modification of ethylene-propylene copolymers with PVC was carried out at a temperature higher than the flow temperature of PVC, which ensures its good dispersion in the mixture and chemical bonding with the elastomer phase, the effect of strengthening the elastic phase with the dispersed PVC phase occurs

**Keywords:** Ethylene-Propylene Copolymer (epr), Polyvinyl Chloride (Pvc), Vulcanization. Compositions, Polymethacrylic Acid. (Pmaa)

## I. INTRODUCTION

**P**urpose: Study of the structure and properties of modified polymers and compositions based on them. The structure of polymers is characterized by the spatial arrangement of the structural elements that make up the macroscopic polymer body, their internal structure, and the interaction between them. The determinant of its main physical properties in a polymer is a macromolecule. All subsequent levels of structure that make up the molecular structure of a polymer depend on the conformation and configuration nature of the macromolecule. When the polymer is exposed to different effects, the molecular structure changes. The shape of the molecular structure, on the one hand, determines the complex physical properties of the polymer body, on the other hand, they depend on the chemical structure of the macromolecule. Shaykh (1998). Turaev et al. (2018). Once the conditions for the crystallization process are created, various forms of molecular structure can form in the crystalline state of the body. This requires the macromolecule to have the necessary regular structure and high flexibility, which provides a certain speed of their regulatory processes.

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Violation of these conditions leads to the formation of an amorphous body with a characteristic molecular structure [1]. Very long inelastic macromolecules, under the influence of intermolecular forces, form glassy polymer bodies with a highly ordered macromolecular structure that can be compared to the order in crystalline bodies [2]. The fibrillar form of the molecular structure is characteristic of such vitreous bodies Shikhaliyev (1998). Amash et al. (2001). Statin et al. (2010). Nueva et al. (2012). Ermirova et al. (2014). In the case of the high elasticity of polymers, macromolecules have the necessary flexibility and certain motion, so the molecular structure of elastomers is less stable and weak because they are more classy, and more crystalline polymers [3]. The molecular surface structure of polymer solutions and alloys is less stable and more mobile Askadsky et al. (1999). Sabbagh et al. (2001)

## II. METHOD

**P**urpose: Study of the structure and properties of modified polymers and compositions based on them. The structure of polymers is characterized by the spatial arrangement of the structural elements that make up the macroscopic polymer body, their internal structure, and the interaction between them. The determinant of its main physical properties in a polymer is a macromolecule [4]. All subsequent levels of structure that make up the molecular structure of a polymer depend on the conformation and configuration nature of the macromolecule. When the polymer is exposed to different effects, the molecular structure changes [5]. The shape of the molecular structure, on the one hand, determines the complex physical properties of the polymer body, on the other hand, they depend on the chemical structure of the macromolecule. Once the conditions for the crystallization process are created, it is possible various forms of the molecular structure can forestall the state of the body [6]. This requires the macromolecule to have the necessary regular structure and high flexibility, which provides a certain speed of their regulatory processes. Violation of these conditions leads to the formation of an amorphous body with a characteristic molecular structure. Very long inelastic macromolecules, under the influence of intermolecular forces, form glassy polymer bodies with a highly ordered macromolecular structure that can be compared to the order in crystalline bodies [7]. The fibrillar form of the molecular structure is characteristic of such vitreous bodies Bunjali et al. (2007). Abon et al. (2003). Serenko et al. (2007), Zaikin et al. (2012). In the case of the high elasticity of polymers, macromolecules have the necessary flexibility and certain motion, so the molecular structure of elastomers is less stable and weak because they are classy, and more crystalline polymers [8].



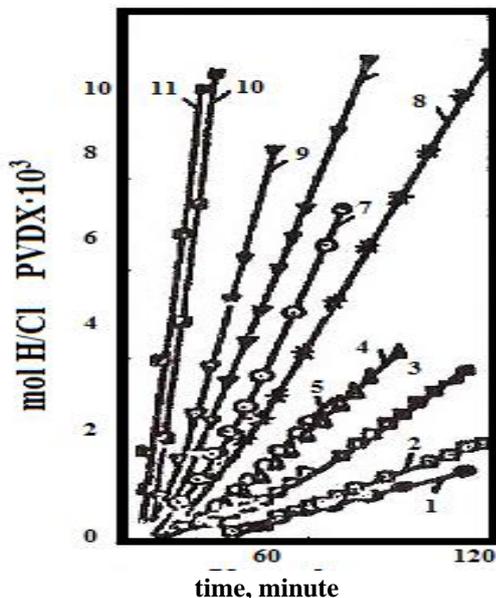
## Investigation of the Properties of Compositions Based on Modified Polymer Mixtures

The molecular surface structure of polymer solutions and alloys is less stable and more mobile Kurbanova(2008). Derik at. el (2014).Derik at. el(2014.)Almirola(2014)

The effect of their structure and composition on the complex physical and mechanical properties of polymers modified by graft copolymerization is ambiguous [9]. This is mainly explained by the heterogeneous nature of the chemical modification process taking place on the surface of the molecular structure [10]. As shown, the vaccine copolymerization creates microheterogeneous areas in the molecular structure of the polymer, which determines the valuable practical properties of these modified polymers and the compositions based on them [11]. An increase in the amount of PVC in a modified ethylene-propylene copolymer increases the melting point (TS) of the copolymer. - 141.5 in Tar- EPR; In EPR -PVDC (13% by weight) -185; In EPR - PVDC(polyvinylidene chloride) (63% by weight) it is -200 ° C. This reduces the rate of thermal destruction of the modified polymer. Velocity is constant thethdestructionon of PVDCin the temperature range of 140-180 ° C - mol N / q; PVDX / min. 105, increasing from 0.3 to 20.3. In modified copolymers, this figure varies as follows: EPR -PVDX -63% by weight) -9.14 to 13.8; EPR -PVDC-PMAA (PVDC-37, PMA 9.5% by weight) - from 0.2 to 13.2; EPR -PVDC-PMÄA (PVDC-50, PMAA 13.5% by weight) - varies from 0.2 to 12.5, ie the thermal destruction of customers is significantly slowed down [12].

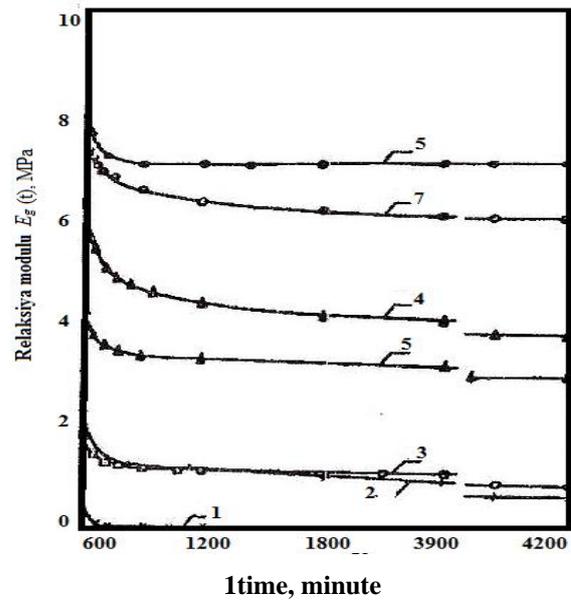
Extraction of EPR from modified copolymers with 53 and 63% mass PVDC is very low after 48 hours and is at the level of extraction rate of EPR -based vulcanizers [13]. This confirms that in the modified copolymer, an intermediate structure is formed as a result of the chemical bonding of the polymers of the system Belov at. el (20012).Kuleznev at. el(2012).Kerem(2020).

EPTP -60 is a synthetic ethylene-propylene rubber polymer  
EPR - ethylene propylene rubber  
PVC- polyvinyl chloride  
PVDC-polyvinyl dene chloride  
PMAA-polymethacrylic  
DKP- Dicunil peroxide3.Result (Figure1)



**Figure 1. Thermal destruction of PVDC-modified EPR at different temperatures and amounts of PVDX over time**

Under the dynamic conditions of the EPR -PVDC copolymer, in the temperature range -50-r + 50 ° C, the change in softness modulus (E) and the tangent angle of mechanical losses - tgb (E''/E') show the relaxation characteristic of glass polymers [14]. The maximum tgb corresponds to minus 50 ° C for unmodified EPR and minus 60 ° C for modified EPR (13.6% by weight PVDC). The TPB maximum does TPB correspond to the transition point E [15]. The expansion of the relaxation areas of the maximal copolymers indicates the formation of an intermediate structure as a result of the interaction of the connected phases with each other's internal structures (Figure 2).

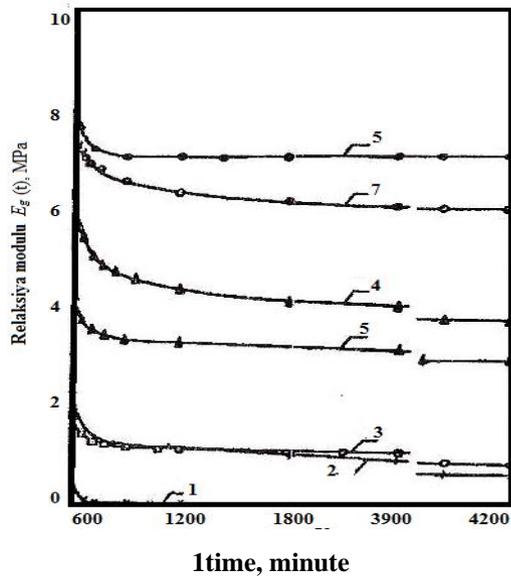


**Figure2. Temperature dependence of the tangent of the dynamic modulus and the angle of mechanical losses. f3 - unmodified EPR; 2, 4 - Modified-Asian EPR with PVDC (13.6% by weight).**

The values of the relative elongation ( $\epsilon_g$ ) of the modified copolymer in traction are higher. The value of  $\epsilon_g$  of the mechanical-pseudo homogeneous mixture is 36% (Figure 3). The mechanical softness properties of polymers are fully expressed by their relaxation properties [16]. The process of isothermal (25 ° C) relaxation at a given constant deformation of stress ( $E = 0.15$ ) was studied, the results of measuring  $f(t)$  in the form of the time dependence of the relaxation modulus  $\epsilon_g(t) = f(E)$ , given by Maxwell-Wichert's model of delayed softness:

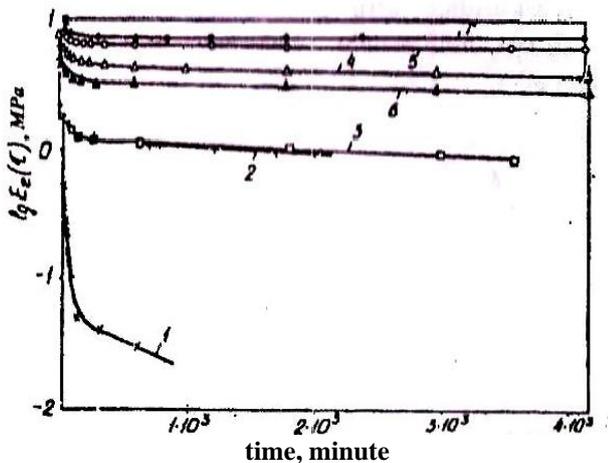
$$E_r(t) = E_\infty + \sum_{i=1}^n E_i (e^{-t/\tau_i}) \quad (1)$$

The unmodified EPR is characterized by a very small - 0.5MPa starting  $E_r$  (o) module. Due to the high elasticity of the polymer, the stress relaxes very quickly, and after 10 minutes the  $E_r$  value is -0.03 MPa and then decreases to zero. The relaxation curves of a modified EPR are significantly different from the relaxation curves of an unmodified polymer [17]. As the amount of modifying polymer (PVDX) increases, the  $E_r$  (O) value increases to 8.0 MPa. Equilibrium modulus of high elasticity in the relaxation curves of modified polymers  $E_z(t)$  arises and its value



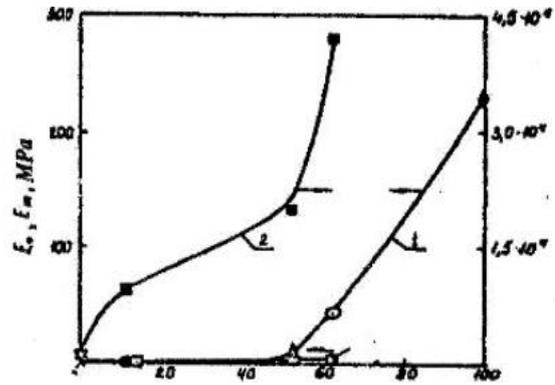
**Figure 3 Relaxation time spectra of EPR (1) and PVDC-modified EPR. Amount of PVDC, % (mass): 2 - 7.2; 3 - 13.3; 4 - 53.3; 5 - 63 (T = 25 ° C); 6 - 53.3; 7 - 63 (T = 80 ° C).**

The spectrum of relaxation time is plotted graphically as  $\lg H^-(\tau) - \lg t$ , taking into account  $H^-(\tau) = 2,303 H^-(\tau)$ . The value of the  $H^-$  (LG  $\tau$ ) function increases. An increase in temperature increases the rate of relaxation processes. (Figure 4). This characterization of relaxation properties is explained by the formation of a stable spatial structure in the modified polymer at high temperatures [18].

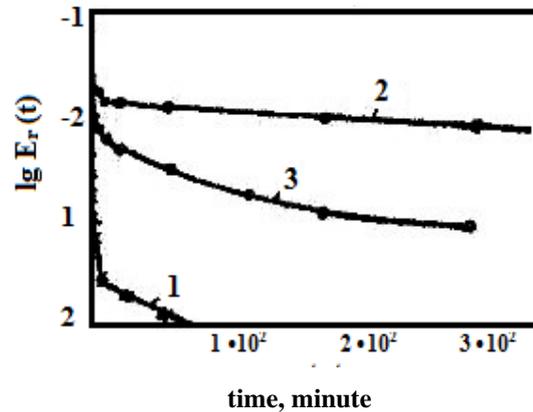


**Figure 4. Relaxation module time dependence. EPR modified with EPR (1) and PVDC: amount of PVDC, % (mass): 2 - 7.2; 3 - 13.3; 4 - 53.3; 5 - 63 (T = 25 ° C); 6 - 53.3; 7 - 63 (T = 80 ° C).**

Given that the Maxwell-Wincher model does not allow to accurately estimate the large relaxation time We have defined in the form of the dependence of  $E(t)$  on time. The relaxation curves in the coordinates  $\lg E_r(t) - t$  determine with maximum accuracy the maximum stress relaxation time  $\tau_m$  and the value of the relaxation modulus  $E_m$  in the following relationships (Figure 5). in a relaxing system, the relaxation of the stress can be determined using the formula given by A [19]. amount of polyvinyl chloride, mass fr



**Figure 5. Dependence of  $E_0$  (1),  $T$ ; „(3) and  $E_m$  (2) on the amount of PVDC in the modified EPR**

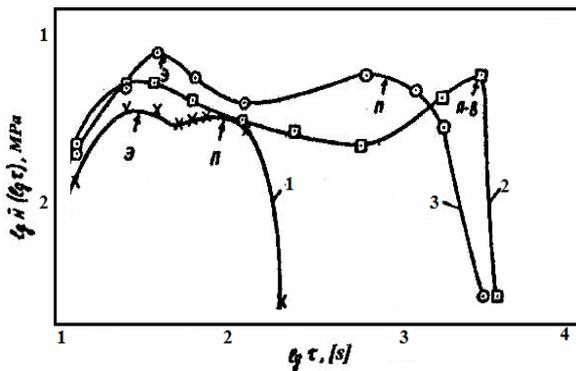


**Figure 6. Relaxation module Time dependence of  $E_r$ . 1- EPR; 2 - EPR modified with PVDC (PVDC-17% (by weight); 3-system obtained by mechanical mixing (T = 25 ° C).**

$$\lg \alpha = \frac{1}{2,303 \cdot \tau_m}; \lg E_m = B \quad (2)$$

where:  $\alpha$ - LG is the bending angle on the  $E_m(t) - t$  curves; B is the cut-off obtained when this dependence continues to the value to. The initial softness modulus (instantaneous softness modulus) is determined by the linear area of the dependence of the stress  $f$  on the value of deformation ( $-\epsilon$ ) at a constant rate of deformation -50mm / min. The values of  $\tau_m$ ,  $E_m$  and instantaneous softness modulus  $E_0$  are given as their dependence on the amount of modifying polymer in the copolymer (Figure 6). The values of  $E_m$  corresponding to the values of the maximum relaxation time  $\tau_m$  are significantly lower than the values of the initial softness modulus  $E_0$ . For the EPR -PVDC (PVDX-53% by weight) copolymer,  $E_0 = 9.6$  MPa, and  $E_m$  is 3.2 MPa. For the copolymer EPR -PVDC (PVDC-63% by weight),  $E_0 = 46$  MPa and  $E_m$  is 7A MPa. Thus, the relaxation time spectra are given for the systems shown in Figure 6 fully describe the mechanical properties of the modified copolymers. As shown, the mechanical mixtures of modified polymers and modified and made polymers differ significantly in their relaxation properties [20].

In unmodified polymers and mechanical mixtures, the relaxation process is completed very quickly, but in modified cool, yes the change in  $E_r(t)$  is very small, even after a long time (Figures 7).



**Figure 7. Relaxation Time Spectra of Epr and Pvc-Modified EPR**

1 - EPR ; 2 - modified EPR (PVDC- 13.3% (by weight)); 3 - mechanical mixture EPR -PVDC - 17.3% (by weight)

There are two distinct maxima in the relaxation time spectrum of the unmodified ethylene-propylene copolymer, one of which characterizes the relaxation time of the more mobile parts of the copolymer in the macro chain, and the other of the relaxation time of the less active parts of the macro chain. Mechanical and chemical modification causes various changes in this part of the spectrum [21]. The second maximum, which indicates the formation of new clusters in the macro chain of the copolymer as a result of chemical modification, is more characteristic, ie the modified copolymer has a wider spectrum of modified relaxation time. In mechanical mixtures, the relative values of elongation at the break -  $\epsilon_p$  compared to modified copolymers and the insignificant spectrum of relaxation times are explained by inhomogeneity, which leads to the concentration of internal stresses at the phase boundary or the mechanical junctions of macromolecules of different natures Alizade(2022). During the processing of polymers with functional groups in the macromolecule, the concentration of these groups results in the formation of polyfunctional nodes [22]. For example, the formation of polyfunctional vulcanization nodes (PFVN) under the influence of vulcanization or heat significantly improves the physical and mechanical properties of rubbers. The properties of such compositions depend on the molecular structure of the polymer, the size and internal structure of the microheterogeneous vulcanization node, etc. is determined by Shixaliyev (2020,2021) Polyfunctional knots and assemblies are also formed in the compositions of polymers modified with vinyl monomers Belov at [23]. el(2012).Shixaliyev(2021) Tensile strength  $f_{300} = 0.74$  during vulcanization of unfilled compositions of an ethylene-propylene copolymer modified with polymethacrylic acid (PMAA) with 1 part by mass of decalin peroxide (DP); FG-2.9 MPa;  $1/Q = 0.28 \cdot 10^{-2}$ , an increase in EPR + DP compositions is explained by the concentration of carboxyl groups in a poorly constructed composition. As the amount of PMAA in the modified copolymer increases, the physical and mechanical properties of the compositions based on these copolymers improve, which is the result of the accumulation

of large amounts of carboxyl groups. Modification with 2.7 and 5.9% mass PMAA. When vulcanized by copolymer-based compositions, 10 parts (mass) of MgO, ZnO, and CaO, they are close in properties to carboxylic rubbers vulcanized with Mg and Zn methacrylates. With chalk-shaped lime (MgO - 30-31, CaO - 53- 55,  $Al_2O_3$   $SiO_2$ ,  $Fe_2O_3$ ,  $TiO_2$ ,  $MgO_2$ , etc. 0.5 to 3-5% by weight) filled, modified copolymer, metal oxide, and 2.0 parts (mass) of DP have higher tensile strength compared to the included compositions. This is explained by the sorption and chemical interaction of carboxyl groups with metal oxides. With 20% (mass) PMAA, the modified copolymer is well processed, the ingredients are easy to incorporate and in large quantities [24]. Compositions of the modified ethylene-propylene copolymer obtained in the presence of DP in the amount of 1-2 parts (mass) and 20 parts (mass) MgO, along with other improved properties, have a high coefficient of aging due to durability. This is explained by the fact that the composite covalent and "salt" vulcanization network is not formed. The improvement in the physical and mechanical properties of PMAA-modified polymers is also explained by the formation of "salt" vulcanization nodes, consisting of unreacted metal oxide particles and ion groups of direct "salt" structures [25]. The amount of 1-1.5 equivalent metal oxide (MgO) per MAA equivalent is sufficient to obtain sufficient values of the properties of the compositions. Compositions based on copolymers modified with 10-15% PMAA and filled with technical carbon have higher tensile strength, resistance to tearing, abrasion, heat aging, and low swelling in oils and solvents compared to unmodified compositions (Figure 10). The construction efficiency of ethylene-propylene copolymer with peroxides, especially di cumin peroxide, is not noticeable and the construction efficiency of some rubbers is the same, %: (butadiene synthetic rubber) BSR + 30-0.8, (styrene-butadiene rubber) SBR +3.2 (synthetic rubber nitrile butadiene), SRNB-18 +7.1 and It is EPTP-26. Compositions based on EPR filled with 15% by weight of EPR (based on 100 (by weight) of modified copolymer: sulfur-0.4; MgO -20; technical carbon PM-50 vulcanization at  $160^\circ C$ ,  $40 \pm 2$  minutes . during) the equilibrium swelling index in benzene, the difference in swelling rates in the mixture of vulcanizes in benzene and benzene-dry acetic acid (-2.5% by weight), the total construction rates were determined. Peroxide-metal oxide vulcanization in these compositions increases the efficiency of construction due to interfacial connections [26]. When the amount of di cumin peroxide DKP in modified copolymers increases by more than 2 parts (mass), the physical and mechanical properties of the compositions change little, and for vulcanization of unmodified EPR requires 3.0 parts (mass) of DKP. The total construction rate in these compositions is  $0.861 \cdot 10^{-2}$ . In the modified copolymer, this degree of construction is obtained in the amount of 1 part (mass) DKP. The build-up rate of 15% (mass) PMAA-modified copolymer and 10 parts (mass) MgO-incorporated composition is 7 times higher than that of the unmodified copolymer. The above compositions were obtained according to the same recipe [27].

Heat to compositions based on unmodified copolymer. the degree of their construction does not change during the impact. During the thermal effect on the compositions based on the modified copolymer, as a result of recombination of

"salt" bonds, an increase in tensile stress, durability value,  $s$ , and the degree of construction is observed. Modified copolymers with PMAA of 10-15% by weight (Table 1. ) have been proposed for the production

**Table 1. Properties of Modified and Unmodified Ethylene-Propylene Copolymer**

Indicators	EPTP -50	
	Not modified	Modified
Viscosity for munitions, MB-1-4-100	48±5	52±5
Unsaturation,% mol.	-	0,1 ±±0,02
Characteristic viscosity, dl / q.	1,65±0,1	1,52±0,1
Hardness, H	3,7±0,2	4,2±0,3
Elastic recovery after stiffness determination, MM	0,6±0,04	0,9±0.04
Glassing temperature, ° C	Mənfı 50÷52	Mənfı 55÷63
Medium viscosity molecular mass ( $M_{\eta} \cdot [10]^{-5}$ )	1,7-1,8	1,5-1,6

The modified copolymer has low thermal plasticity and its elastic recovery is higher than that of the unmodified copolymer. This is due to the formation of a branched structure during modification. The technological properties of compositions based on modified and unmodified copolymers are similar. Modified EPR -15% (by weight); PMAA-100; DKP-2,0; Mg0-20. The number of remaining substances in both compositions: sulfur - 0.4; technical carbon PM50-30. Vulcanization at 160 ° C for 40 ± 2 minutes.

**III. DISCUSSION**

Compositions based on modified ethylene-propylene copolymer have complex improved properties compared to unmodified copolymers. As a result of the modification of ethylene-propylene copolymers, in principle, the

improvement of their properties is due to the formation of "salt" bonds during intermolecular and vulcanization due to functional groups. Compositions based on ethylene-propylene modified with methacrylic acid and acrylic nitrile have high mechanical properties and swelling resistance in solvents. Due to these properties, the compositions are similar to the compositions based on SRNB-18 but differ significantly from them in terms of heat resistance. Due to their complex properties, modified compositions with 10% (mass) PMAA and 4-5% (mass) PAN have been proposed for the production of rubber products. The high molecular weight (3-3.5) · 10<sup>4</sup> modified copolymer of PMAA vaccine kits does not allow us to take full advantage of it. While the tensile strength of the filled compositions is 18.04-22.0 MPa, in unfilled compositions this figure is 6 + 7 MPa. (Table 2)

**Table2 Physicochemical Properties of Compositions Based on Modified and Unmodified Ethylene-Propylene Copolymer**

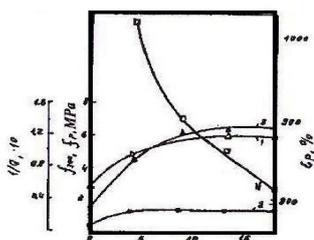
Indicators		APR	
		Not modified	Modified
1.	Conditional stress at 300% elongation, MPa	8±0,5	12±0,5
2.	Conditional tensile strength, MPa		
	At 20 ° C	16±1	19+1
	At 100 ° C	10±0,5	13,5±0,5
3.	Relative elongation at break,%		
	At 20 ° C	460±20	450±23
	At 100 ° C	200±20	260±13
5	Coefficient of resistance to heat aging (144 hours, 100 ° C):	0,96±0,05	1,17±0,06
	1) due to conditional durability in traction;	0,89±0,05	0,84±0,05
	2) due to the relative elongation at break		
5	Elasticity of return,%		
	At 20 ° C	48±2	40±3
	At 100 ° C	54±2	45±3
6	Tear resistance, kN / m	46±3	61 ±3
7.	Toul	75±4	42±5
8	Heat generation according to Goodrich, ° C	78±2	85±2



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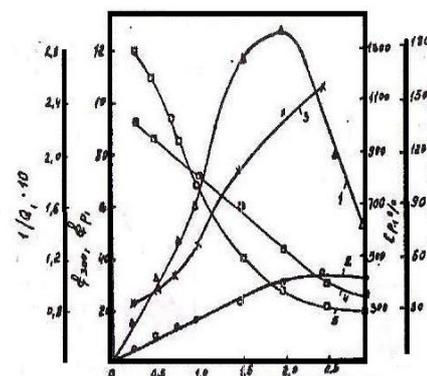
9.	Hardness according to TSM-2, MPa	1,2±0,05	1,4±0,06
10.	Swelling rate,% by mass		
	- VM-4 oil, for 13 days, at 20 ° C	61,5±5	34,5±4
	- Carbon dioxide, 24 hours, 20 ° C	400±22	280±20
	"Galosh" brand gasoline, 16 hours, 20 ° C	180±14	115±14
	- Benzene, 16 hours, 20 ° C	120±10	90±10
11.	Electrical resistance, mV / m	27,0±2	41,0±2

This confirms that the properties of microheterogeneous vulcanizers depend not only on the size of the vulcanization nodes but also on the number of contact of the vulcanization nodes with the polymer, which is inversely proportional to the molecular weight of the groups involved in the formation of vulcanization nodes. During the chemical modification of the polymer-monomer system, the molecular weight of the vaccine groups depends on the nature of the vinyl monomer and the conditions under which the vaccine copolymer is obtained. The molecular weight of methacrylic acid clusters in an acrylamide-modified copolymer is (1, 35-1, 5) -104, ie the MOL-modified copolymer is twice the molecular weight of PMAA. Therefore, in copolymers with the same amount of PMAA and methacrylic acid in the macromolecule of the modified copolymer, there are many sites of methacrylic acid groups. IR spectrographic analysis confirmed that as the amount of methacrylic acid in the modified copolymer increases, the intermolecular interactions in the system increase. Increasing the amount of methacrylic acid from 5 to 10% by weight leads to a significant increase in the degree of construction of vulcanizers and, accordingly, their durability properties. An increase in methacrylic acid(MAA) of more than 10% by weight does not lead to a significant change in the properties of vulcanizates, which is explained by the formation of a certain degree of vulcanization powder of polyfunctional vulcanization nodes and their subsequent splitting (Figure 8 and 9). Compositions based on EPR-MAA mechanical mixtures obtained under the conditions of synthesis of modified copolymers do not have appropriate physical and mechanical properties. The same effect is observed when acrylamide and methacrylamide are added to the compositions. As previously explained, these amides are explained by the fact that in the solid phase at a vulcanization temperature of -150-160 ° C, they polymerize rapidly to form high-molecular-weight polymers. To reduce the rate of polymerization, the effectiveness of vulcanizing agents, especially DKP, is reduced when the temperature is reduced. Replacement of vaccinated MAA with pre-polymerized MAA as a result of the absence of interfacial chemical bonds during vulcanization



**Figure 8 .modified, unfilled EPR vulcanizates with tensile strength  $f_p$  (1) 300% tensile stress construction rate  $1/Q$  (3); dependence of the relative elongation on the amount of ep MAA, the amount of DKP - 1k / h does not**

strengthen the unmodified copolymer. Because PAA does not mix with the ethylene-propylene copolymer, it remains a separate heterogeneous phase in the system and does not participate in the formation of a multifunctional vulcanization network. Chemical modification of ethylene-propylene copolymer with AA provides the participation of vaccine MAA groups in the formation of interfacial chemical bonds and increases the durability properties of compositions based on the modified copolymer. In a modified copolymer, the molecular weight of the vaccine MAA groups can be changed over a wide range, thereby controlling the properties of the copolymer. When heated, acrylamide polymers are subjected to internal and intermolecular imitation with the release of ammonia. The amount of ammonia released increases from 150 to 190 ° C (Figure 13). Based on EPR PAA, the amount of ammonia released from the vulcanizates of the compositions is less than that of the non-vulcanized compositions, because part of the  $NH_3$  is released during the vulcanization process. In compositions containing 15 parts (mass)  $MgO$ , the release of  $NH_3$  is reduced, which is explained by the interaction of some amide groups with  $MgO$ . The release of  $NH_3$  during the vulcanization of these compositions is small and does not affect the durability properties of vulcanizers. The optimum density of DKP during vulcanization of EP-MAA copolymers is up to 1.5 parts (mass) of the modified copolymer. Increasing the amount of DKP increasing the amount of vulcanizates Sustainability of vulcanizates amount of polyvinyl chloride, mass fr

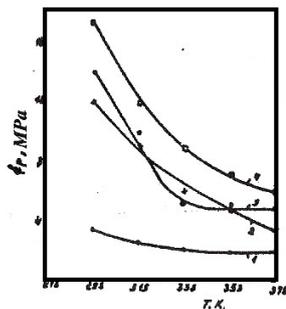


**Figure 9. MAA modified EPR vulcanizates with tensile strength PHP (1), 300% tensile strength f300 (2); dependence of the degree of construction  $1/Q$  (3), the relative elongation up (3), and the residual elongation f300 (4) from the amount of AA, the amount of MAA - 18% (mass).**

Vulcanization at 155 ° C for 40 min. causes deterioration of its properties. This is due to the concentration of orientation and interaction of amide groups as the number of constructions in the copolymer mass increases.

When the amount of DKP in the compositions is increased to 3 parts (mass), the degree of construction does not change and the tensile strength is significantly reduced to the level of durability of the unmodified copolymer (Figure 9). In the presence of metal oxides, as a result of the adsorption interaction of unsaturated compounds with metal surfaces, they affect the formation of vulcanization structures and allow the production of compositions with high physical and mechanical properties. The physical and mechanical properties of compositions based on MAA-modified copolymers with the addition of 15 parts (mass) MgO, CdO, and ZnO are higher than the physical and mechanical properties of compositions based on unmodified copolymers, regardless of the type of metal oxide. The strengthening effect in these systems is explained by the sorption interaction of MAA vaccine groups with the polar surface of metal oxides and the effect of this bond on the formation of polyfunctional vulcanization nodes. In these compositions, the stress is confirmed by relaxation values at 20 ° C. Tension relaxation in compositions based on modified EPR -PAA copolymers with and without metal oxide lasts 150-170 minutes. Relaxation in compositions based on peroxide vulcanized, unmodified copolymer is completed within 70 minutes. As a result of the concentration of amide groups in the compositions based on modified copolymers and the formation of sorption bonds of acrylamide grafts with the surface of metal oxides, the strengthening of the intermolecular bond leads to the formation of the second maximum in the relaxation curve. - Tensile strength of compositions based on propylene copolymer is reduced from 3.2 MPa to 1.9 MPa, and in compositions based on modified copolymers from 12 to 2.5 MPa. Such a significant decrease in tensile strength in compositions based on modified copolymers is due to the nature of the intermolecular bond. In the presence of metal oxides, in compositions based on modified polymers, the durability is reduced to 56 MPa due to the strengthening of intermolecular bonds and the role of metal oxide as a reinforcing filler.

The formation of multifunctional nodes in the presence of metal oxides of functional groups of modified copolymers and their effect on intermolecular interactions are confirmed by the indicators of true destructive stress  $\sigma_g$ , temperature dependence. As the temperature increases,  $\sigma_g$  decreases for all the above compositions, the highest value of  $\sigma_g$  at 100 ° C is observed in compositions based on EPR -PAA copolymers with the addition of metal oxides (Figure 10 and 11).



Sheki Figure 10 Temperature Dependence of the Tensile Strength of Vulcanizers.

EPR + 1.5 mass h. DKP (1); EPR P-MAA + 1.5 mass h. DKP (2); EPR -MAA + 1.5 mass h. DKP+15 mass h. CdO (3); EPR -MAA + 1.5 mass h. DKP +15 mass h. MgO.

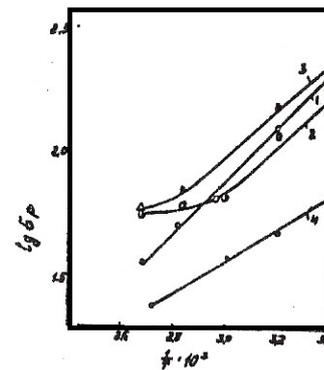


Figure 11. Temperature Dependence of the Actual Shear Stresses of Vulcanizates.

Metal oxide of EPR -MAA vulcanizate (1); With MgO (2); C (3); Peroxide vulcanizate of EPR The structure of the vulcanization network is characterized by the coefficients Q and C<sub>2</sub> in the Muni-Rivlin formula. In non-swollen specimens, C<sub>2</sub> characterizes the normal molecular surface structure, so the value of the C<sub>2</sub> coefficient should be higher in compositions based on modified copolymers with polar groups and intensive intermolecular bonds. ( Figure 12.).

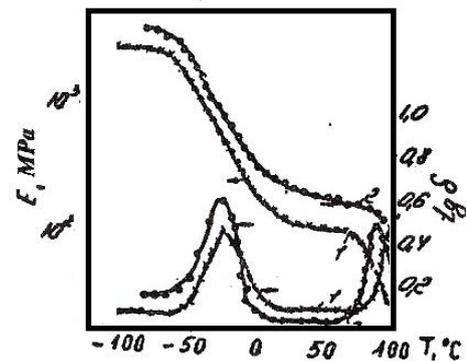


Figure 12. EPR (1) and / 7 = 200 cycles / min. Temperature dependence of the dynamic modulus of the copolymer (2) extracted after thermal-mechanical exposure (60:40) and the tangent of the angle of mechanical losses under the conditions.

The so-called elasticity coefficient - the value of C<sub>2</sub> is higher in compositions based on EPR -PAA (18% by weight PAA) than in compositions based on unmodified EPR. In EPR -PAA-based compositions, increasing the amount of structural decimal peroxide does not increase the value of C<sub>2</sub>. The addition of metal oxides to these compositions leads to an increase in the C<sub>2</sub> coefficient, which is the strengthening of the intermolecular bond. C<sub>2</sub> value in compositions based on modified copolymer with 15 parts (mass) MgO added, based on modified EPR, without the addition of metal oxide, 1.8 times compared to compositions (from 182 to 332 Kappa), and on compositions based on unmodified copolymer 2, Increases 72 times (from 122 to 332 Kappa).

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The best properties of the compositions are achieved in the presence of aerosol fillers, which is explained by the fact that the cost of the specific surface of the aerosol is higher than that of kaolin, chalk, and chalk-shaped lime. To reduce the cost of the compositions, it was suggested to use chalk-shaped lime as a filler - a filler rich in metal oxides. The compositions continue to form weak vulcanization nodules during the aging process at 100 ° C for 96 hours, due to the chemical bonding of the metal oxides inside the filler - the chemical bonding of the CONH<sub>2</sub> groups and the formation of internal and intermolecular bonds of the amide groups. One of the main reasons limiting the use of EPR in the production of rubber products is its low resistance to oil and gasoline. Modifications of EPR MAA increase the resistance of the compositions based on it to oil and gasoline, and these compositions have been proposed for use in the production of rubber products. Compositions based on EPR -MAA have been proposed for use in the cable industry due to their dielectric properties. Inclusion of functional groups -COOH, -CONH<sub>2</sub>, -Cl and -CN in the macromolecule of the ethylene-propylene copolymer, in compositions based on them - to reduce the amount of DKP by 1.5-2 times and rich in technical carbon and other organic fillers, metal oxides, allows you to replace it with mineral fillers. Compositions based on ethylene-propylene copolymer modified with vinylidene chloride in the emulsion are close to the properties of compositions based on chlorinated EPR, but from these compositions, 300% tensile strength, tensile strength, heat aging, and so on. are significantly different. Modified isobutylene-isoprene copolymer (IIC) - polyacrylonitrile-based compositions, significantly outperform unmodified IIC in terms of heat, chemical resistance, hardness, and abrasion resistance. The vulcanization rate of modified IIC is high, even at low temperatures. Compositions based on IIC-PMAA have high hardness, friction resistance, oil and gasoline resistance, fracture resistance. This is explained by the formation of a concentrated secondary structure with a high intermolecular bond in the presence of vaccinated chains, fillers, and metal oxides, in contrast to the unmodified copolymer. Compositions based on IIC-PMAA copolymers with% (mass) PMAA were used in the manufacture of diaphragms for tire vulcanization. Compositions based on copolymers containing PNAK and PMAA in large quantities - 20% (by weight) have been proposed for the production of rubber-technical products in contact with various solvents Shixaliyev(2021) Compositions based on EPR pey.-PAN have been used in the production of rubber-technical products as high-quality and advanced materials. Compositions based on EPR -pay.-PMAA, IR-pey.-PNAA can be used in various fields of polymer materials production. EPR -per-PAN copolymers containing 25% (mass) PAN, along with high physical and mechanical properties, have a higher chemical resistance than compositions used in the industry based on SRNB-18, SRNB-26, SRNB- 40, and EPTR-60. While the cold resistance of compositions based on these modified copolymers is minus 70 ° C, the negative in compositions based on SRNB- 26 is 43 ° C, and in SRNB-40 is minus 26 ° C. This is because the functional groups are in the side chain of the vaccine and the elasticity of the main macromolecule is maintained. Compositions based on EPR -per-PAN

copolymers have high cold resistance, as well as high resistance to oil, gasoline, and heat, characteristic of nitrile elastomers, and a high degree of fracture strength Modified EPR -PAY-PAN copolymers mix well with polar and non-polar polymers, which allows modified copolymers and polar SRNB- 26, chlorinated polyethylene mixtures to withstand heat, oil, gasoline, cold and chemical resistance. Preparation of compositions containing Rubber-technical products used in the conditions of heavy and extreme operation were obtained from the prepared compositions. Sealants obtained from these compositions were tested in deep exploration wells at a temperature of 270 ° C, a pressure of 160 MPa, and H<sub>2</sub>S and oil drilling conditions Compositions based on EPTR-pey-PAN and BK-pey-PAN copolymers filled with cement and alumina during synthesis have a high friction resistance of -16 and 28 cm<sup>3</sup> / kWh, respectively. Compositions based on copolymers filled in the synthesis process are used in the oil engineering and oil extraction industries. In the process of synthesis, compositions based on asbestos, glass particles, and their mixture EPTR-pey.-PAN have high thermal physical properties, their depth of destruction is reduced by 50 + 100%, and at the same time, high-temperature resistance remains negative at a temperature of 54-52 ° C. Modified polyethylene high pressure( -pey-PAN copolymers, their types filled in the synthesis process, polyethylene high pressure (PHP)+ EPTR-pey.-PAN copolymers have relatively high technological and physicomechanical, as well as thermal physical properties of PHP.

Modified copolymers differ from YSPE by higher antistatic properties. The specific surface resistance of YSPE is 8.0 · 10<sup>16</sup> OM. The specific surface resistance of modified copolymers is approximately -6.4 · 10<sup>10</sup> Ohms. This allows to significantly expand the field of application of these copolymers. As shown, polyolefins modified with unsaturated acids, in addition to the presence of ionic groups, have high flexibility of the macromolecule of polyolefin, so they can be used to obtain ion-exchange materials. Modified copolymers of polyolefins have low density, high softness, impact resistance, friction resistance, and electro-insulating properties. The presence of small amounts of carboxyl groups in the built-in body of PMAA-modified ethylene-propylene copolymer and polystyrene mixture improves the exchange properties of sulfocationite - the hydrophilicity of the granular particles increases and the swelling of the cation sites increases significantly. These confirm the progress of modification of ethylene-propylene copolymers for the introduction of macromolecular ionogenic groups and the production of ion-exchange materials based on these copolymers. Copolymers with functional groups have a wide range of applications in other fields. Dispersions of modified ethylene-propylene copolymers were used in the "technical fabric-modified polymer-based composition" system to study the effect of functional groups on bond strength. The dispersion of ethylene-propylene copolymer was modified by mechanical mixing in certain proportions with MAA-monomer and PMAA-polymer.

The bond strength obtained by mechanically modified EPR dispersion differs little from the bond strength obtained by non-modified dispersion because when MAA and PMAA are mechanically mixed with ethylene-propylene dispersion, they remain as a separate phase in the system. They are neutralized when alkali is added to maintain a certain level. Absorbents based on chemically modified ethylene-propylene dispersion, rubbers with 22V and 23K industrial technical parts, and their mixtures: natural rubber NR+BSK + SKI-3, EPTP 50, EPTR-60, between compositions based on BK and XBK, have higher performance creates bond strength. Impregnated technical fabric-EPR and EPTP -based composition bond strength is higher than impregnated technical fabric and TR + BR + isoprene rubber-based bond strength. This is explained by the natural proximity of the phases in the first case. The dependence of the bond strength in the system on the amount of PMAT in the dispersion exceeds the maximum and this maximum is equal to 5% (mass) of PMAA. A change in the

amount of PMAA in the dispersion from 5 to 20% (mass) leads to a decrease in bond strength, which is explained by a decrease in mobility due to an increase in the molecular weight of grafted chains with functional groups in the modified polymer. This reduces the density of the intermolecular bond at the "technical fabric-adhesive-composition" boundary. This is because the presence of a large number of polyvariate groups in absorbent compositions based on dispersions of polymers with a high degree of modification complicates the complete bond between the adhesive macromolecule and the substrate. Dispersions based on modified EPR (5% by weight PMAA) and industrial dispersions produced by EPR by Montecatini-Edison - Latex 1/5 and Latex 1/7 - are given in Table 3. As the amount of dry residue of the adhesive increases, the bond strength in the "technical fabric-composition" system increases, but the stability of the dispersion deteriorates

**Table.3. The bond strength created by EPR dispersions in the "technical fabric 22V- EPTP based composition" system**

Name of variance	Amount of dry residue,% by weight	Contact strength, , H 10 <sup>-3</sup> ,H		H-method, 10 <sup>-3</sup> H/M
		120°C	160°C	
Modified dispersion of EPR	4,1	1,9	1,1	3,1
“-“	8,0	2,0	1,2	6,1
“-“	11,0	2,4	1,2	9,2
Latex 1/7	11,0	2,0	1,2	7,2
Latex 1/5	18,0	2,3	1,2	8,2

The amount of dry residue in the modified dispersion, taking into account the complex adhesion properties of the technological V6 complex, is assumed to be 4-6% (by weight). Between compositions based on a mixture of a technical fabric (22V and 23K) and NR + (styrene-butadiene rubber)SBR + IIR-3 rubbers, modified ethylene-propylene dispersion with a dry residue of 4.1% (by weight) and industrial latex with a dry residue of 9% by weight, the same level of contact provides durability (Table 4). When 23K

technical fabric is impregnated with adhesive based on modified EPR dispersion, the bond strength at the "23K technical fabric-adhesive-composition" boundary is higher than the bond strength at the 23V technical fabric-adhesive-composition boundary. Modified EPR dispersions are obtained and stored in a thermostat at 130 ° C for 30 minutes. The thin layer has high durability and elasticity. At pH 10 + 12, the dispersion lasts for 6 months. it is stable at a temperature of -30 ° C.

**Table 4. Strength of connection between modified EPR and industrial latex "technical fabric NR + SBR + isoprene rubber composition**

Latex-based absorbent ingredients	Amount of dry residue,% by mass	Contact strength, 10 <sup>-3</sup> H, 120 ° C		H method, 10 <sup>-3</sup> H/M			
		22V	23 K	20°C		120°C	
				22V	23K	22V	23 K
Modified dispersion of EPR	4,1	1,21	1,35	5,0	6,0	3,0	4,0
Modified latex of EPR	6,1	1,30	1,45	4,0	5,0	5,0	4,0
Latex SDR-1 + DMVP-10> (70:30)	9,0	1,34	3,40	7,0	6,0	5,0	4,0

After 6 months of storage, the wetting capacity of the dispersion - surface tension 42-f-50 MH / M and viscosity 3 + 1 MPa-Provide its good technological and physical-mechanical properties. The temperature and time dependence of the adhesion resistance of the modified dispersions is such that when the temperature increases from 20 to 160 ° C, a significant decrease in the adhesion resistance occurs at the "adhesive-composition" boundary. The effect of temperature after vulcanization increases the contact resistance in the "technical fabric-composition" system. The composition based on the mixture EPR ÷ (chlorinated butyl rubber) CBR

(3% by weight Cl<sub>2</sub>) -90: 10 provides high contact resistance at the "technical fabric-adhesive-composition" boundary with the absorbent composition based on the modified EPR dispersion. This is due to the increased co-location and intermolecular bonding in the system with the participation of CBR EPR dispersion modified with methacrylic acid is similar in basic properties to industrial carboxylated latexes,

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but also superior to industrial latex in terms of adhesion strength in the "technical fabric- EPR or EPR -based composition" system. Expansion of the use of latexes in industry and their use - carpets, non-woven materials, water-emulsion paints, paper, etc. production, as well as the use of modified EPR dispersion in the production of these products. Coatings were obtained from a modified dispersion of the copolymer EPTR -60 with methacrylic acid to protect tire tires from atmospheric influences (459-460). Based on a mixture of SIR and divinyl rubber (DR) (30:70), the tread rubber, EPTR -60 modified with MAA, provides the most protective effect, determined by the natural aging coefficient for conditional durability and relative elongation.

If  $\alpha = 0.80$  and  $K_{\epsilon} = 0.76$  for these dispersions,  $K_f = 0.35$  and  $K_{\epsilon} = 0.5$  for unmodified EPTR -60 dispersion and  $K_f = 0.25$  and  $K_{\epsilon} = 0$  for unprotected rubber, 6 have been identified. The above coefficients were  $K_f = 0.72$  and  $K_{\epsilon} = 0.77$  with the addition of chemical stabilizers and rubbed with protective wax. "It simply came to our notice then EPTR-60-based protective coatings exceed the performance of comparable coatings by 60%, chemical stabilizers, and wax-protected rubbers by 40%. Compared to rubbers protected by EPTR-60 dispersion, they have a modulus of 300% elongation -12%, tensile strength -11%, and relative elongation -6%. Obtained in EPTP -60 dispersions.

According to the index of separation of the protective coating in repeated traction, the modified dispersion is 78% higher than the unmodified dispersion.

The ethylene-propylene copolymer was modified with polyvinyl chloride (3.5% by weight) and filled with technical carbon (5% by weight) (451 by weight) to increase the protective effect of the coating during ozone aging. Dispersion of the specified composition: (amount of dry residue - 3.8% (mass), viscosity - 42-45 MPa·S, surface tension - 34-35 mg / m.) Use for protection of tires, natural climate, and ozone aging has been. During 12 hours of exposure, the concentration of ozone -0.0001%, the time before the formation of the rubber layer under deformation of the sample -20% -> 1860 minutes, the coefficient of ozone aging, for conventional completeness - fg -0.96, and relative elongation -  $f_{\epsilon}$  Was -1.0 (451). No exposure to ozone cracks was observed during 12 hours of tire rubber exposure based on Compounds based on synthetic isoprene (SIR) and divinyl rubber. The protective coating obtained by modifying the EPTP -60 dispersion with 7% (mass) epoxy resin and filling it with 5% (mass) technical carbon has a high thermal aging coefficient: FG -0.92,  $f_{\epsilon}$  -0.83 (461, 462). Dispersions based on modified EPR and EPTR are highly effective in protecting tire coatings from the effects of the natural climate and ozone aging during long-term storage and use.

### IV. CONCLUSION

. The decrease in elasticity and increase in hardness of the composition is due to this effect. The reinforcement effect is further enhanced in EPTR -PVC mixtures, which is explained by the presence of a double bond in EPTR. The inclusion of plasticizers in these mixtures increases the mutual dispersion of polymers in the system and the building effect of the mixture. The main factor influencing the interaction of polymers of the mixture in the interfacial layer and their

adhesion to each other is the proximity of the plasticizer to the polymers of the mixture.

### RECOMMENDATIONS

As a result of the modification of EPR and EPTR with vinyl monomers, their adhesion, oil, gasoline and chemical resistance, construction, etc. properties are improved. Carboxyl, amide, nitrile, chlorine, etc. are added to the macromolecule of ethylene-propylene copolymers. inclusion of functional groups, as a result of increased intermolecular bonding, their. further increases heat resistance. Improvement of adhesion properties of ethylene-propylene copolymers has allowed obtaining latexes, adhesives, and absorbent compositions with heat resistance on their basis. The presence of functional groups in modified copolymers increases the degree of construction in the compositions based on them, as a result of the concentration of polar groups. This copolymer builds at a higher rate in the presence of sulfur, rental oxides, and small amounts of peroxides.

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