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DETERMINATION OF RUBBER-CORD CONNECTION ON THE BASIS OF LATEX SYNTHESIZED ON THE BASIS OF ETHYLENE-PROPYLENE RUBBER

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ABSTRACT

The purpose of this work: to obtain latex on the basis of ethylene-propylene rubber and to determine the rubber-cord connection or rather its adhesion on the basis of it.

For the first time, EPR+PMMA latex was obtained by modifying it with methacrylic acid in order to obtain latex based on EPR.

As a result of the experiment, the kinetics of the modification process was studied. It has been shown that when modifying EPR with MAA, the amount of acid should be 5 mass parts, and the co-polymerization process should be carried out for 5 hours and at a temperature of 90°. An adhesive bond with high physic-mechanical properties can be obtained by using a specially formulated absorbent compound to enhance the rubber-cord bond. It was determined that the adhesion relationship also depends on the thickness of the absorbent composition. As the density of the impregnating composition increases, the wetting of the textile fibers with the composition decreases and the contact strength with the rubber decreases significantly.

It was determined that the viscosity of the absorbent composition should be 5-8%. However, the density of EPR+PMMA co-polymer in the used latex should not be lower than 10%. Only in this case, the cord threads can be thoroughly soaked in the absorbent composition.

Keywords: methacrylate acid, poly methacrylate, latex, modification, adhesion, absorbent compound, ethylene-propylene rubber.

Ingredients

Synthetic latexes are widely used in various industries. Latex is an important product used in the tire industry, rubber – in the preparation of technical products, in the medical industry and in the construction industry [1-5].

Latex is basically the main adhesive in the tire industry, which provides the cord-rubber connection in the preparation of the carcass part of the tires. Recently, latexes are obtained by synthetic method mainly by emulsion method [6-10].

On an industrial scale, new latexes are purchased and the equipment used for their synthesis is updated [11-15]. New emulsifiers, coagulation agents are used in technological processes.

Contact of textile goods (cord, cloth, kapron, etc.) with rubber is almost zero without adhesive. Therefore, it is necessary to use adhesives in order to ensure the connection between rubber and textile goods [16-17].

Recently, ethylene-propylene rubber has been used in the production of military tires [18-19].

The adhesive that fully ensures the cord-rubber connection of the carcass part made on the basis of EPR has not been synthesized. In this work, during the production of tires used in vehicles operating under difficult operating conditions, mainly in military aviation, it is the most important and urgent issue to ensure the cord-rubber connection of their carcass part, taking into account all this, we have synthesized latex on the basis of EPR[20-21].

Methodist

After the B-22 brand cord is impregnated and dried with an impregnating compound, after it is rubberized on two sides in a roller, in order to determine the rubber-cord connection, it is subjected to a vulcanization process at a temperature of 155ºC and 20 min. physico-mechanical properties of the vulcanizate obtained after vulcanization during the period were determined by the H-method in a crushing machine [18-20].

The results of the experiment were as follows:

1. Rubber-cord connection –
2. Relative elongation –
3. Residual deformation -

The obtained figures allow us to say that the adhesion of textile goods to rubber can be ensured only by the absorbent composition based on EPR +PMMA joint polymer latex.

Practical importance of the work: since the carcass part of the bag is made of rubberized cord, the adhesion force between the rubber and the textile material determines its operational characteristics. The frame works under very difficult operating conditions (high temperature, repeated deformation, shocks, etc.). Therefore, it is recommended to use an impregnating composition prepared according to the proposed recipe to ensure the rubber-cord strength in order to meet the requirements.

The property of high heat resistance of the used EPR allows to use it in the purchase of carcass resins. It is recommended to impregnate with an impregnating composition based on the proposed EPR+PMMA joint polymer to ensure the rubber-cord connection for the production of the carcass based on EPR.

As a result of this work, the shortcomings of EPR - poor adhesion properties, lack of compatibility with other components, lack of mixing, etc. has been resolved.

Conducted studies have shown that the water dispersion of EPR and its modified samples were obtained and it was shown that it can increase the rubber-cord connection in a wide physical-mechanical range.

Synthetic latexes are currently the most common and main group of latexes used in various fields of the national economy. Their volume is more than 4/5 of the total consumer latex. Almost all of them are obtained by emulsion polymerization of the corresponding monomers. Their properties are mainly determined by the nature of the polymer. The most important synthetic latexes are butadiene-styrene, acrylate, vinyl chloride, etc. The technology for obtaining these latexes is generally the same. Therefore, in other cases, it is considered an example of the most popular butadiene-styrene latexes, the main differences of which are marked.

Discussion

Factors ensuring the adhesive connection of cord-rubber

The adhesive used in the formation of the rubber-cord system is the main factor. Thus, after the cord is impregnated with an absorbent composition based on SKEP rubber, the fibers of the

textile fabric form a strong adhesive bond with the rubber, ensuring the high strength of the rubber-cord system. Our research has shown that the breakdown in these systems can be mainly as follows:

1) Adhesive disintegration;
2) At the adhesive-rubber boundary;
3) Cohesion breakdown.

Disintegration in the cord-rubber-adhesive system must be considered separately in each system. Because the dispersion can go between cord-rubber or rubber-adhesive. In all cases, the strength of the cord-rubber-adhesive system should have a bifilar property and have high adhesion both to the textile product (cord) and to the rubber.

EPR+ PMMA co-polymer developed on the basis of EPR was taken as an adhesive in this work. Assoc. to this system. The modified phenol-formaldehyde resin synthesized by T. Naibova was used and technical carbon was added to the impregnation composition to obtain a binder with high physical-mechanical (MPFR). and adhesion properties.

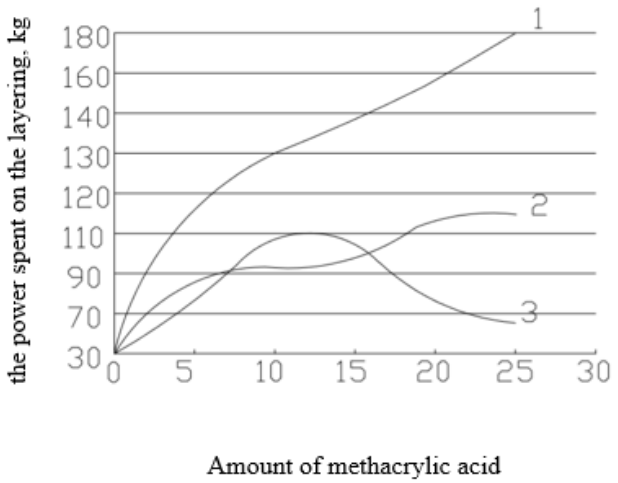

Figure 1. Dependence of MPFR. condensation time on the basis of SKEP+ PMMA resin (1) and strength of polyamide cord

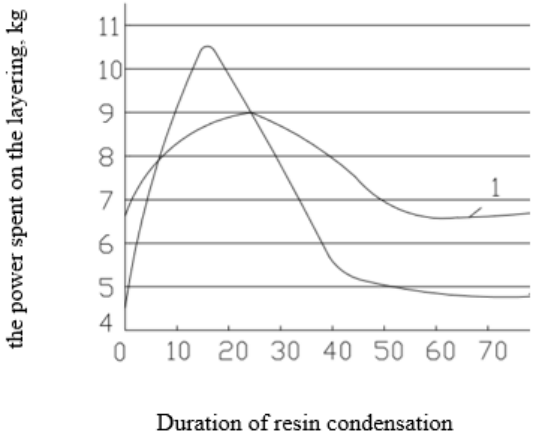

Figure 2. The strength of the rubber-cord connection depending on the amount of MPFR. (1- cord 22B; 2- cord 222B; 3- polyamide cord).

Using MPFR. to determine the viscosity cord-rubber connection strength, the duration of condensation of the adhesive prepared according to the recipe (table 1) and the effect of the amount of resin on layering were studied, and the obtained results are shown in figures 1 and 2.

As can be seen from Figures 1 and 2, increasing the amount of MPFR. first increases the strength relationship sharply and then decreases. We think this is due to the presence of polar functional groups.

EPR was modified with methacrylic acid in order to ensure the strength of the cord-rubber connection. The obtained results showed that the polymer substrate obtained as a result of MAT modification of EPR leads to high adhesion in the cord-rubber-adhesive system.

Our research has proven that one of the important factors influencing the adhesive-rubber relationship is the selection of the recipe of the rubber mixture. In the selection of this recipe, the research works of prof. Since Fariz Amirov and docent Movlayev Ibrahim conducted it, we used the optimal recipe they found.

In the cord-adhesive-rubber system, the weakest area is the adhesive-rubber boundary, where disintegration occurs. It depends on a number of factors. The most important of them are the following:

- Less development of the surface of the system compared to the adhesive-cord boundary;
- Thermodynamic incompatibility of used polymers and components.

Factors ensuring the cord-rubber adhesive bond

The adhesive used in the formation of the rubber-cord system is the main factor. Thus, after the cord is impregnated with the absorbent composition made on the basis of EPR rubber, the fibers of the textile fabric form a strong adhesive bond with the rubber and ensure the high strength of the rubber-cord system. Our research has shown that the breakdown in these systems can be mainly as follows:

4) Adhesive disintegration;
5) At the adhesive-rubber boundary;
6) Cohesion breakdown.

Disintegration in the cord-rubber-adhesive system must be considered separately in each system. Because the dispersion can go between cord-rubber or rubber-adhesive. In all cases, the strength of the cord-rubber-adhesive system should have a bifilar property and have high adhesion both to the textile product (cord) and to the rubber.

Preparation of the impregnating composition

Hopper content should be 8.0% dry matter, and pH should be 8.8-9.0. A pre-determined mass of absorbent is added to determine the dry residue of the absorbent. The accuracy of the result should be 0.0012. After soaking in the soaking bath containing the absorbent at room temperature, we placed it in a drying cabinet with a temperature of 165-175^{o}C, and after drying to a constant mass, the dry residue was 0.001 g. We theoretically calculated the dry residue as a percentage (p) with the following formula:

$$p_{\,dryq.} = \frac{m \cdot 100}{m_n}$$

where – m is the mass of dry residue, q; mn – the mass of the absorbent composition.

The pH of the soaking composition is determined in a pH meter. The shelf life of the impregnating composition in the industry should be 3 days.

Table 1. Researched and optimal absorbent composition recipe

The name of the ingredient	per 100 mass parts of rubber, mass fraction	The mass of the component	The dry residue of the component according to the hop content
Latex SKEP+PMMA	100	240	67,2
Resorcinol-formaldehyde resin FFQ	52,2	256	33,8
Technical formalin	36,6	504	12,5
NaOH 10%	25,4		2,5

Study of the effect of the amount of carboxyl groups on the rubber-cord connection

Latex obtained on the basis of EPK, the amount of acid in the co-polymer obtained by modification with methacrylic acid is 5-25 parts by mass. In order to study the adhesion property of the rubber-cord connection, an absorbent composition was prepared based on the purchased latex, and after soaking and drying the viscose cord (22B) with the absorbent composition, it was tested by the method given in Chapter 2. For this purpose, a rubber mixture was prepared according to the following recipe. (fiqure 3.)

Cord-rubber connection was studied depending on the amount of -COOH groups in the samples obtained as a result of vulcanization.

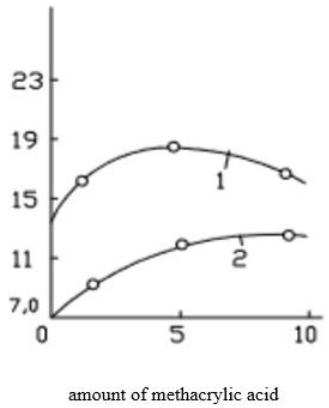

Figure 3. Cord-rubber connection depending on the amount of -COOH groups in samples obtained as a result of vulcanization: 1. Viscose cord; 2. Kapron saw.

Investigation of the effect of technical carbon on rubber-cord strength

To increase the strength of the rubber-viscose cord connection, the systems were impregnated with a composition obtained by adding to this technical work during the preparation of the impregnating composition. adhesive properties of the system are widely known research methods, mainly the H-method. The results obtained are presented in Figure 4.

As can be seen from Figure 4, when using a modified resin and carbon black, the cord-rubber bond increases by 1.5 times. This is explained by the fact that the physical and mechanical properties of the impregnating composition increase sharply.

In this case, intermolecular interaction increases.

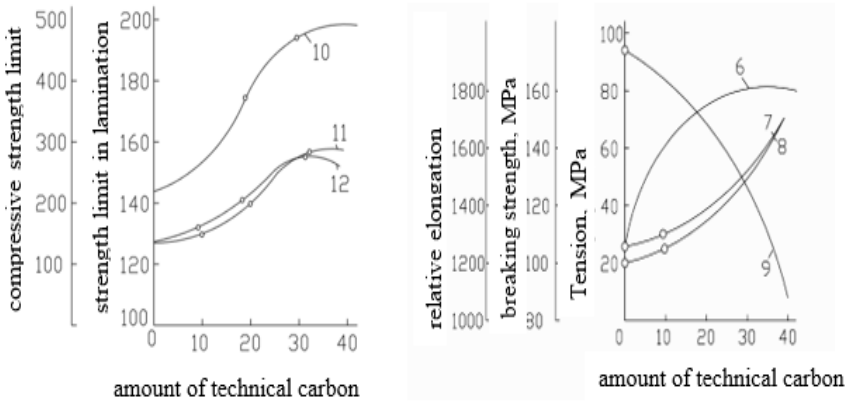

Figure 4. Effect of technical carbon on rubber-cord bond strength of viscose cord impregnated with absorbent composition obtained by giving technical carbon.

The use of resorcinol-formaldehyde resin in the impregnating composition.

In the standard impregnating compositions, resorcinol-formaldehyde resin of brand СФ-282 is used. However, due to the fact that this resin is not economically efficient, in this case, Assoc. We used phenol-formaldehyde resin synthesized and modified by Naibova. As a result of the research, we determined that when using phenol-formaldehyde resin, it is necessary to add a hardener to the composition.

The composition easily penetrates between all the threads of cord and technical fabrics and thereby thoroughly wets them and gives the threads a special softness, which leads to a noticeable increase in wettability and gives the threads a special softness, which leads to a noticeable increase in strength. rubber-cord connection. So we have done extensive research work. In this case, we increased the dry residue of the absorbent composition to 5%. In this case, a modified phenolformoldehyde resin was used as an absorbent to ensure the strength of the connection of rubber-cord systems, in which, as a result of the modification, the phenol content remained less than 3%. The data obtained is shown in Figure 5 and shows that when the cord-rubber contact changes depending on the amount of phenol-formaldehyde in the absorbent, the adhesive strength of thesystem sharply increases

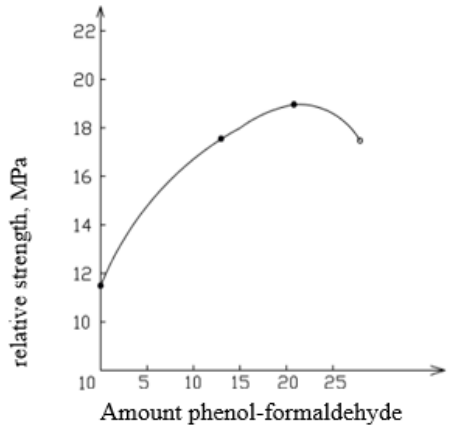

Figure 5. Variation of cord-rubber contact depending on the amount of phenol-formaldehyde in the absorbent

Results

1. Aqueous dispersions of EPR latexes were synthesized by using different emulsifiers, distinguished by their high technological stability. The values of the main factors affecting the stability and adhesion properties of the EPR aqueous dispersion were determined. It was shown that the best durability is achieved at pH=12 for 6 months.
2. EPR aqueous dispersions do not provide the necessary level of strength at the cord-rubber interface. It was determined that the mechanical mixtures of EPR with MAK and PMAK do not have sufficient adhesion strength at the cord-rubber phase boundary
3. The modification of aqueous emulsion of EPR was carried out on the basis of copolymerization with the presence of MAK. General kinetic regularities of emulsion of EPR in MAK were determined. It has been shown that the optimal conditions are as follows: temperature - 90 ^{o}C, time - 5 hours. Under these conditions, the monomer conversion reaches 90%. In order to determine the structure of the gel copolymer, SKEP, it was subjected to a comprehensive physicochemical study.
4. The physio-mechanical and adhesion properties of latex containing 2-20 mass parts of polymethacrylate (PMMA) were studied, and as a result, it was determined that the absorbent obtained on the basis of latex containing 5 mass parts of stitched PMMA had more cord-rubber connection.
5. The strength of connections of 17B, 22B AND 23K cords wetted with Perlative's in chlorinated butyl rubber containing 3 to 27 mass % of chlorine was studied on the basis of various rubbers. It has been shown that systems based on combinations of rubber with RPR + MAA and EPR + ХБК have high adhesion properties.
6. It has been shown that modified EPR latex provides high adhesion resistance of cotton-paper and Capron fabrics to rubber. The strength of the connection of Capron cloth with EPR rubber reaches 20 kg·s/ 2.5 cm.
7. It has been shown that modified EPR latexes are not inferior to EPR latexes of "Montecatini-Edison" company in terms of strength indicators of the connection at the cord-rubber boundary, and the industrial carboxyl-containing СКД-1 latex surpasses the aqueous emulsion of butyl rubber.
8. The principle scheme of the technological process of preparation of EPR aqueous dispersion, its modifications and preparation of wetted compositions based on them was developed.
9. The possibility of effective use of synthesized latexes in various areas of rubber production has been shown.

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ETİLEN-PROPİLEN REZİN ƏSASINDA SİNTEZ EDİLMİŞ LATEKSDƏ REZİN-KORDON ƏLAQƏSİNİN MÜƏYYƏN EDİLMƏSİ

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XÜLASƏ

Bu işin məqsədi etilen-propilen kauçuk əsasında lateks əldə etmək və onun əsasında rezin-kordon birləşməsini, daha doğrusu onun yapışmasını təyin etmək olmuşdur. İlk dəfə EPR+PMMA lateksi lateks əldə etmək üçün EPR-i metakril turşusu ilə modifikasiya edilərək əldə edilmişdir. Təcrübə nəticəsində modifikasiya prosesinin kinetikası öyrənilmişdir. Göstərilmişdir ki, EPR-nin MMA ilə modifikasiyası zamanı turşunun miqdarı 5 kütlə hissəsi olmalıdır və sopolimerləşmə prosesi 5 saat ərzində və 90^{o}C temperaturda aparılmalıdır. Yüksək fiziki-mexaniki xassələrə malik bir yapışma əlaqəsi, yəni rezin-kordon əlaqəsini gücləndirmək üçün xüsusi hazırlanmış uducu birləşmədən istifadə etməklə əldə edilə bilər. Müəyyən edilmişdir ki, yapışma əlaqəsi həm də uducu tərkibin qalınlığından asılıdır. Uducunun tərkibinin sıxlığı artdıqca, toxuculuq liflərinin tərkiblə nəmlənməsi azalır və rezinlə təmas gücü əhəmiyyətli dərəcədə azalır. Müəyyən edilmişdir ki, uducu tərkibin özlülüyü 5-8% olmalıdır. Bununla belə, istifadə olunan lateksdə EPR+PMMA sopolimerinin sıxlığı 10%-dən aşağı olmamalıdır. Yalnız bu halda, kordon ipləri absorbent tərkibdə yaxşıca islatıla bilər.

Açar sözlər: metakrilat turşusu, polimetakrilat, lateks, modifikasiya, yapışma, uducu birləşmə, etilen-propilen kauçuk

ОПРЕДЕЛЕНИЕ СВЯЗИ РЕЗИНО-КОРД НА ОСНОВЕ ЛАТЕКСА, СИНТЕЗИРОВАННОГО ИЗ ЭТИЛЕН-ПРОПИЛЕНОВОГО КАУЧУКА

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РЕЗЮМЕ

Цель данной работы был получить латекс на основе этиленпропиленового каучука и определить на его основе резинокордное соединение, а точнее его адгезию. Впервые получен латекс ЭПР+ПММА путем его модификации метакриловой кислотой с получением латекса на основе ЭПР. В результате эксперимента была изучена кинетика процесса модификации. Показано, что при модификации ЭПР МАК количество кислоты должно составлять 5 массовых частей, а процесс сополимеризации проводить в течение 5 часов и при температуре 90о. Клеевое соединение с высокими физико-механическими

свойствами можно получить, используя специально разработанный абсорбирующий состав для усиления соединения резина-корд. Было обнаружено, что соотношение адгезии зависит также от толщины впитывающей композиции. По мере увеличения плотности пропиточного состава смачиваемость текстильных волокон составом снижается и значительно снижается прочность контакта с резиной. Определено, что вязкость абсорбирующей композиции должна составлять 5-8%. Однако плотность сополимера ЭПР+ПММА в используемом латексе не должна быть ниже 10%. Только в этом случае нити шнура можно тщательно пропитать впитывающим составом.

Ключевые слова: метакрилатная кислота, полиметакрилат, латекс, модификация, адгезия, впитывающий компаунд, этиленпропиленовый каучук.