RUBBER COMPOUND FOR RUBBER-METAL PRODUCTS, PRESSURED

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https://doi.org/10.5281/zenodo.7317002

Abstract. *The aim of the study is to study the effect of oil refining waste on the properties of elastomeric composite materials. It was found that in its presence in a thiuram curing system, the relative rate of cis-1,4-polyisoprene vulcanization increases, the time to reach the optimum vulcanization decreases, but the degree of vulcanization, proportional to the maximum torque, decreases, and when a sulfur vulcanizing system is used, it activates the vulcanization process, which is facilitated by the presence of active functional groups in its composition (-OH, -COOH and etc). It is shown that the tensile strength and elongation of vulcanizates increase, while the elasticity remains at an average level.*

Keywords: *rubber, glass transition temperature, plasticizer, thermal aging, structure, vulcanization kinetics, elasticity, composition.*

РЕЗИНОВЫЙ КОМПАСИОН ДЛЯ РЕЗИНО-МЕТАЛЛОИЗДЕЛИЙ ПОД ДАВЛЕНИЕМ

Аннотация*. Цель исследования - изучение влияния отходов нефтепереработки на свойства эластомерных композиционных материалов. Установлено, что в его присутствии в тиурамовой вулканизующей системе увеличивается относительная скорость вулканизации цис-1,4-полиизопрена, уменьшается время достижения оптимальной вулканизации, но снижается степень вулканизации, пропорциональная максимальному крутящему моменту, а при использовании серной вулканизирующей системы активизирует процесс вулканизации, чему способствует наличие в ее составе активных функциональных групп (-ОН, -СООН и др.). Показано, что предел прочности при растяжении и относительное удлинение вулканизатов увеличиваются, а эластичность остается на среднем уровне.*

Ключевые слова*: каучук, температура стеклования, пластификатор, термическое старение, структура, кинетика вулканизации, эластичность, состав.*

INTRODUCTION

The creation of ingredients for polymeric materials based on local raw materials is an important task for ensuring the smooth operation of the production of composite elastomeric materials. As is known, the introduction of plasticizers increases the molecular mobility, decreases the viscosity, and decreases the glass transition and fluidity temperatures of the polymer. The condition that determines the possibility of practical application of a low molecular weight substance as a plasticizer is its compatibility with the polymer - the ability to dissolve in it, causing swelling, which is achieved by the proximity of the energy of intermolecular interaction of the polymer and the low molecular weight component.

In the light of the foregoing, in this article, the results of a study on the use of oil refining waste on the properties of composite elastomeric materials to obtain rubber-metal products working under pressure .

METERIALS AND METHODS

The objects of study are oil refining production wastes, as a standard rubber mixture, were used on the basis of isoprene, chloroprene and styrene- butadiene rubber. The production of

rubber compounds was carried out on laboratory mixing rollers RC-WW 150/330 (Rubicon, Germany). The determination of the Mooney viscosity of rubber compounds was carried out on a Mooney viscometer MV 2000 (Alpha Technologies, England). The stress relaxation test is carried out on the same specimens as the Mooney viscosity immediately after the completion of the viscosity measurement by stopping the rotation of the rotor very quickly and measuring the drop in the final Mooney viscosity over time. The vulcanization kinetics of rubber compounds was determined on an ODR 2000 rheometer (Alpha Technologies, UK). Technical indicators were determined according to the relevant state standards.

RESULTS

The main research methods are the determination of the glass transition temperature of polymers and fluidity. In this regard, the influence of oil refining waste (OR) on the glass transition temperature of elastomers was studied, based on measurements of deformation and modulus of elasticity.

Table 1.

Influence of OPN Content on the Glass Transition Temperature of Rubbers

Name and content of plasticizers, wt.h.	Name of rubbers and glass transition temperature, K			
	SKI-3	Nairit KR-50	SKMS-30RP	SKN-18
0	203-205	263	221	218
DBF 5	201	261	219	216
ten	199	258	215	214
fifteen	192	255	213	211
OPN 5	201	260	219	215
ten	198	256	215	213
fifteen	190	254	112	210

The study showed that as the OPN content increases, the glass transition temperature of elastomers naturally decreases. This means that in the presence of OPN, the elastomers retain their highly elastic properties at lower temperatures than unplasticized elastomers. In this case, a frequency dependence of the deformation and the value of the glass transition temperature is observed. The higher the frequency, i.e. the shorter the exposure time, the higher the glass transition temperature of the plasticized system. Based on the study , it was found that with an increase in the content of OPN, the glass transition temperature of elastomers can be lowered very much. In this regard, too much OPN should not be added to the rubber, as this can cause a sharp decrease in the pour point and narrow the temperature range of high elasticity.

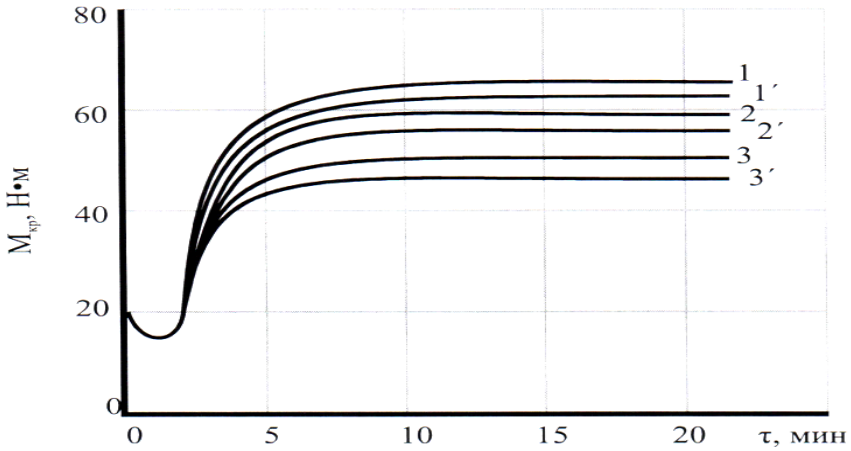

Fig.1. Kinetics of vulcanization of rubber compounds based on SKI-3 rubber at a temperature of 428K. The content of OPN and DBP 5 (1.1 [1]) and 15 (3.3 [1]) wt.h. per 100 wt.h. rubber.

It is known that plasticizers slow down the formation of vulcanization structures (grids) with various types of cross-links. The influence of OPN on the kinetics of vulcanization of rubber mixtures based on SKI-3 rubber has been studied. It has been established that in the presence of OPN in the thiuramic vulcanizing system, the relative rate of vulcanization of cis-1,4 - polysoprene increases, the time to reach the optimum vulcanization decreases (Fig. 1.) , but the degree of vulcanization decreases, proportional to the maximum torque. When using a sulfur vulcanizing system, OPN activates the vulcanization process, which is facilitated by the presence of active functional groups in its composition.

(-OH, -COOH, etc.). The observed effect is confirmed by IR spectroscopic studies of the reaction products of OPN and thiuram at elevated temperatures. A sharp decrease in intensity at 1720 cm $^{-1}$ related to the C=O groups of the carboxyl group and a slight decrease in the region of 360-300 cm $^{-1}$ (OH group) indicate that when OPN is combined with thiuram, new products are formed with the participation of these groups . The study of the effect of the amount of OPN on the properties of rubbers based on SKMS-30 ARKM-15, SKI-3, nairit KR-50 showed that its optimal dosage is 10 wt.h per 100 wt.h of rubber. At the same time, the tensile strength and relative elongation of the vulcanizates increase, while the elasticity remains at an average level. Hardness and stress at 300% elongation and tear resistance in all studied rubbers with the introduction of OPN increase in comparison with dibutyl phthalate. The stabilizing effect of OPN was studied during the oxidation of technical and purified with chloroform, followed by a threefold reprecipitation of synthetic rubber SKS-30 ARCM-15 and nairit KR-50 with isopropyl alcohol. With an increase in the OPN content in SKS-30, ARCM-15 increases the duration of the slow stage of the oxidation reaction (induction period), and the rate of oxygen uptake at deep stages, after the end of the induction period, practically does not change. At the same time, the effectiveness of the same OPN concentration in unpurified rubber is higher than in purified rubber, which is apparently due to the presence of the antioxidant BC-1 in the latter (Fig. 2) . Interestingly, at high OPN concentrations, an increase in the induction period is accompanied by an increase in the rate of oxygen uptake during the induction period. Similar patterns were observed in the inhibited oxidation of polyolefins and were explained by the oxidation of the inhibitor by molecular oxygen.

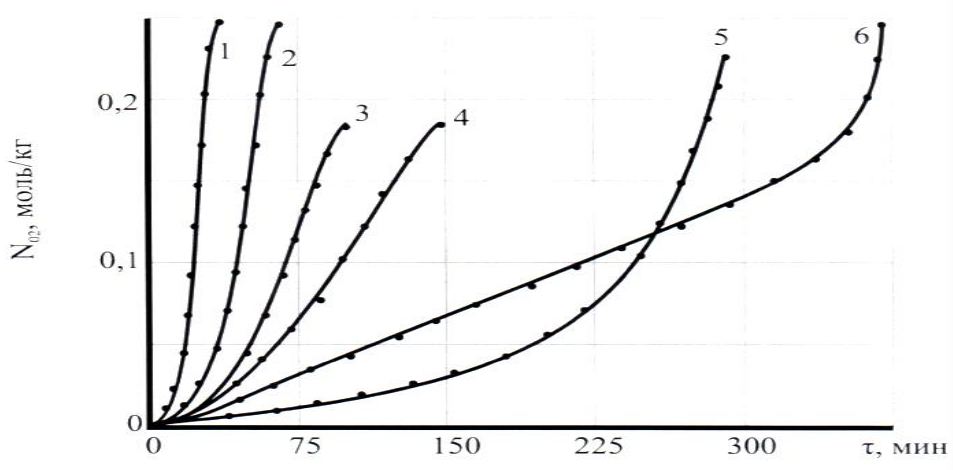

Fig.2. The kinetics of oxygen absorption during the oxidation of purified (1,2,5) and unpurified (3,4,6) SKS-30ARKM-15 in the absence of additives (1,4) and in the presence of 10% OPN (5.6) and MOPN (2, 3); T= ^{1600} .

DISCUSSION

Of 0.07 and 0.014% (1.4.10 $^{-3}$ and 2.4.10 -3 $^{mol / kg)}$, respectively, for crude and purified rubber . The critical concentrations of OPN during the oxidation of technical and purified SKS-30 ARKM-15 correspond to 0.24 and 0.5%, which is significantly higher than for DBP. The effective consumption constants of OPN in SKS-30 ARCM-15 are 3.2 · 10 $^{-4}$ s $^{-1}$ for purified and 1.9 . 10 $^{-4}$ s $^{-1}$ for technical rubber, which indicates its great influence on side reactions to inhibit the oxidation of elastomers. Studies of the thermal aging of composites stabilized with OPN have shown that with an increase in the duration of aging, other things being equal, there is a decrease in the relative elongation of composites stabilized with OPN oligomers compared to samples stabilized with neazone D. Apparently, additional structuring under the action of oxygen-containing products, as a result of which there is an increase in rigidity and a decrease in relative elongation.

CONCLUSION

Thus, the experimental data show the feasibility of using OPN as effective modifying additives for elastomer compositions and rubber-metal products based on them operating under pressure, which makes it possible to control the structure and, therefore, the properties of the compositions without a radical change in the technological processes of their production.

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