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EFFECT OF GAMMA IRRADIATION ON MECHANICAL AND STRUCTURE PROPERTIES OF ELASTOMER BLEND FILLED WITH DIFFERENT TYPES OF CARBON BLACK

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Abstract: Research project, carbon blacks were produced by furnace (S324) and channel(K354) methods were added to elastomer mixture and vulcanization process carried out with gamma rays and physical-chemical properties are learned. Two types of fillers with different amounts were included to composite material which formed by based on butadiene nitrile rubber nano zinc oxide particles and disulphurchloridebenzyl used as crosslinking agent. The obtained mixture was vulcanized by 250 kGr gamma rays. It is shown that, strength, hardness and the stiffness of vulcanized materials are causes to change the physical-mechanical properties. Moreover, impact of the amount and type of filler. According to the influence of the elastomer mixed with fillers improves the yield amount of carbon-rubber gels (CRG).

Keywords: Elastomer blends, NBR, Radiation vulcanization, Carbon black filler, nano-ZnO

1. Introduction

It is known that, according to vulcanization type the fillers used in this process impact to physical-chemical properties of elastomer materials. Although, the methods which were carried out with the sulphur and peroxide were mostly used, lots of investigations based on production of elastomer materials with ionization rays were studied in the latest years. It is determined that, thermo-chemical vulcanization process carried out at high temperature with catalysts has many advantages in comparison with radiation vulcanization process. Therefore, mechanical properties of the material, durability to high temperature and other exploitation properties are improve by the help of formation of C-C chemical bondin elastomer material by gamma rays, row bond and change in polymer chain structure. [1]

There are carried out several investigations towards to construction process in macromolecules influenced by gamma rays and impact of different factors. In addition, nature of the filler, its dimensions and special density of surface influence vulcanized material`s features.

In order to accelerate the vulcanization proses and reduce the building time some chemicals such as, several accelerators, chlorinated compounds and nano oxide metal powders are introduced to system.

Using carbon black (CB) as filler in elastomer improves mechanical and technological properties of materials. In addition, it is actually efficient in economic aspect to increase the amount of elastomer materials. Having carboxyl, phenol, hydroxyl, aldehyd and ketone groups on the surface of fillers causes formation of the chemical bond on the surface of carbon black-elastomer.

For getting desirable results, the type of filler, its it amounts according to 100 phr fraction of polymer and mutual absorption forces between polymer-filler phase boundaries should be considered.

In this research, the impact of disulphochloride benzyl (DSCB), ZnO nano powder and radiation doze to butadiene-nitrile based rubber, building yield, structure and physical-mechanical properties of elastomer mixture are investigated. The actual aim of this research is exploring exploitation properties and chemical conversions which carbon black involves carbon black and impacted by γ- rays. [3]

During investigation, the influence of various branded carbon black on the plastic-elastic and physical-mechanical properties of the NBR-ZnO-DSCB, obtained by radiation-technological method, was studied.

2. Materials and methods

Butadiene-acrylonitrile rubber was copolymers of butadiene (BC) and acrylonitrile (AN) produced by means of an emulsion polymerisation reaction initiated by redox catalyst systems. The content of acrylic nitrile (AN) was 40% in the molecule. The Mooney viscosity was (ML1+4 (100°C):47).

As activation crosslinking of polymer used nano zinc oxide (ZnO). With the introduction of ZnO, nanopowders pay attention to the dimension (20-25nm) dispersion and purity (99.8). Specific surface (250 g/m^2), true density 5.606 g/sm^3. Powder dosage was varied in the range 0.8-4.0 phr. The nanomaterials had been obtained from the Inc. Houston, TX, USA.

In the process used crosslinking agent disulphochloride benzene (DSCB) aromatic compounds, which react readily with macromolecules NBR. DSCB is an organosulfur compound with the formula $C_6H_5(SO_2)_2Cl_2$ It is a colourless viscous oil that dissolves in organic solvents, but reacts with compounds containing reactive N-H and O-H bonds.

Furnace blacks F324 - active, highly dispersed, obtained by thermo-oxidative decomposition of liquid hydrocarbon raw materials, with a high dispersion index and an average structural index. Channel black C354 -active, obtained in a diffusion flame with thermo-oxidative decomposition of natural or associated gas.

Nanocomposites based on NBR were prepared on two roll-mixing mills (outside diameter 470 mm, working distance 300 mm, a speed of slow roll 24 rpm and fraction ratio of (1:1.4) in accordance with ASTM D3182-07.

The gamma irradiation process was carried out in Co^{60} source of γ-radiation facility (D=4.9 kGy/h) represented at the Institute of Radiation Problems, Azerbaijan. The tensile strength and elongation at break are measured by using a Zwick (Germany)

The nanocomposite samples for mechanical tests carried out on dumbbell shaped specimens of 4 mm width and 50 mm length. Tensile strength (TS), elongation in break % (E_b), and modulus at 100% elongation were determined measured in accordance with ASTM D-412 using a tensile testing machine P-5. [4]

3. Results and discussion

It is known that, while formation of phase net due to absorption in polymer molecule and accelerating of crosslinking process in elastomers one of the main considerations is structure of CB. Thus, the technical characteristics of the elastomer have a positive effect on the strength properties of both factors as a result of the influence of both factors on the chain strand, as well as their interaction, elastomer-CB connections, and its output. Chemical composition of CB differs due to the nature of hydrocarbons that used in production and its formation method. The existence of the functional groups on the surface of carbon black can influence in both positive and negative ways to characteristics of elastomer mixture.

During the research in order to improve the impact of recommended fillers on elastomers chemical structure and enhance characteristics of the vulcanizate a combination of 2 different type of carbon blacks used and also the influence of CB and its combination on structure parameters, plastic-elastic and mechanical properties is investigated.

According to 100 mass part of NBR based polymer mixture, 60 mass part of compound involves S324 and K354 branded fillers at different ratios and vulcanisation process is carried out.

CB	According to 100 mass part of rubber				
S 324	60	40	30	20	0
C 354	0	20	30	40	60

DSCB was added as accelerator and also as building agent to the obtained nanocomposites (NBR-DSCB-ZnO-CB). Their plastic-elastic properties are shown in the table.

The results of investigators prove that, the impacts of CB combinations on NBR based mixtures are various. The viscosity of CRG in 4th system which involves S324 and K354 is greater than other systems and 1st system has the lowest amounts.

Table. The plastic-elastic characteristics of mixture of carbon blacks (S324, K354) elastomers

Properties	NBR-DSCB--ZnO-C354 (60:0)	NBR-DSCB-ZnO- C354-P324 (40:20)	NBR-DSX-ZnO-C354-F324 (30:30)	NBR-DSCB-ZnO-C354-F324 (20:40)	NBR-DSCB-ZnO-F324 (0:60)
	1	2	3	4	5
Mooney viscosity	40	55	62	68	65
Hardness, Hs	2000	1600	1500	1400	1200
Plasticity, ş. v.	0,55	0,42	0,37	0,4	0,33
CRG, %	48	55	62	68	57
Elasticity, mm	2,2	2,8	3,2	3,7	3,0
Elasticity, ε %	36	42	48	51	40

Including carbon black in different ratios has positive effect on plasticity and elasticity characteristics of mixture. The lowest increase rate of is observed at elasticity.

As shown in the table samples which is not involves or partly involves C-354 branded carbon black has lower hardness than other samples.

4. Conclusions

Including CB into mixture is influencing negatively to formation of carbon structure in nanocomposites. At the same time, in order to get any result only certain amount of second carbon black should be added into mixture.

There is a rise in the Mooney viscosity due to formation of the weak carbon structure and increase in amount of RCG. It is determined that, canal type carbon black is poorly distributed in NBR based blends. Introducing S324 branded CB before C354 makes distribution improvements in second mixture and it is creating a desirable condition for carbon structure formation. Thus, during the vulcanisation of NBR based nanocomposite, it is more effective to introduce a combination of S324 and C354 branded carbon blacks compared to adding them separately and its advantageous for enhancing plastic-elastic and physical-chemical features of elastomer mixture.

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MÜXTƏLİF MARKALI TEXNİKİ KARBON DOLDURUCULU ELASTOMER QARIŞIQLARININ MEXANİKİ VƏ QURULUŞ XASSƏLƏRİNƏ QAMMA ŞÜALARININ TƏSİRİ

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Xülasə: Müəyyən olunmuşdur ki, müxtəlif markalı texniki karbonların (S324, K354) qarışığa eyni vaxtda əlavə edilməsi, nanokompozitdə, karbon quruluşlarının yaranmasına mənfi təsir edir. Eyni zamanda istənilən nəticəni əldə etmək üçün, ikinci texniki karbon (K354), qarışığa yalnız müəyyən miqdar nisbətində daxil edilməlidir. Zəif karbon quruluşun əmələ gəlməsi, KKG-nin artması nəticəsində Muniyə görə özlülüyün artması müşahidə edilir. Müəyyən olunmuşdur ki, kanal tipli texniki karbon (K354), BNK əsaslı qarışıqlarda pis paylanır. S324 markalı TK-nun sistəmə K354-dən əvvəl daxil edilməsi, ikincinin qarışıqda paylanmasını yaxşılaşdırır, bu da daha çox karbon quruluşunun əmələ gəlməsinə şərait yaradır. Beləliklə, BNK əsaslı nanokompozitin radiasion vulkanlaşması zamanı, doldurucu kimi S324 və K354 markalı texniki karbonun sistemə tək deyil, birgə kombinasiyalarının daxil edilməsi elastomer qarışığınnın plasto-elastik və fiziki-kimyəvi xassələrini yaxşılaşmasına səbəb olur.

Açar sözlər: Elastomer qarışığı, BNK, Radiasion vulkanlaşma, Texniki karbon, nano-ZnO

ВЛИЯНИЕ ГАММА-ИЗЛУЧЕНИЙ НА МЕХАНИЧЕСКИЕ И СТРУКТУРНЫЕ СВОЙСТВА ЭЛАСТОМЕРНОЙ СМЕСИ НАПОЛНЕННЫХ РАЗЛИЧНЫХ МАРОК ТЕХНИЧЕСКОГО УГЛЕРОДА

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Резюме: Было установлено, что, введение в смесь технических углеродов (П 324, К354) одновременно, отрицательно влияет на образование структуры углерод-углерод связей в нанокомпозитах. В то же время для того, чтобы улучшить результаты, в смесь следует добавить только определенное количество второго ТУ-а. Увеличивается вязкость по Муни из-за образования слабой структуры углерода и увеличения количества ККГ. Установлено, что ТУ типа канальной (К354) плохо распределяются в бутадиен-нитрильном каучуке (БНК). Добавление ТУ

марки П324, перед К 354 улучшает, как указывалось выше, распределение последней в смесях, что способствует образованию более развитой непрерывной углеродный структуры. Таким образом, во время вулканизации нанокомпозита, основе БНК, более эффективно вводить комбинацию сажи S324 и С354 по очереди отдельно и так как благодаря этому улучшается пластико-эластические и физико-химические свойства эластомерных смесей.

Ключевые слова: Эластомерная смесь, БНК, Радиационная вулканизация, Техническй углерод, нано- ZnO