

**ТЕХНИКАЛЫҚ ҒЫЛЫМДАР
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**TECHNOLOGICAL PROPERTIES OF URETHANE RUBBER MODIFIED WITH
XYLITANE POLYESTER**

Abstract

A method for producing urethane rubbers based on polyester xylitane has been developed. Industrial peroxide vulcanizates based on urethane rubber SUR-8IG crystallize at room temperature, therefore, agents forming a more developed spatial structure are used to vulcanize this rubber. The presence of a dense transverse structure reduces the rate of crystallization of vulcanizates.

Urethane rubbers based on known copolymer polyesters do not crystallize and can be vulcanized with organic peroxides, diazocyanates, and a mixture of vulcanizing agents.

The nature of the selected vulcanization system largely determines the properties of the obtained rubbers – their hardness, modulus, residual deformation and other properties, therefore, industrial urethane rubber SUR-8PG can be used to manufacture parts for various purposes. The significant content of methyl groups in polyurethane SUR-8PG prevents crystallization and other intermolecular interactions. Rubber based on SUR-8PG rubber has a good glass transition temperature (T_c), but a relatively low elasticity.

The main task of this work is the synthesis of polyurethane rubber based on xylitane polyesters (SUR-8TBk), obtained from waste from the hydrolysis and fat-and-oil industries, which has frost resistance and high elasticity.

Keywords: technological properties, urethane, rubber, glass transition temperature, viscosity, polyester, xylitane.

Introduction

Urethane rubbers of the SUR brand are one of the types of polyurethane – high molecular weight compounds containing macromolecules in the main chain – repeating urethane groups –O-CO-NH-.

Urethane rubbers differ from plastics, which have properties closest to polyamides, in their molecular weight and structure.

Over 150 brands of SUR are produced in the industry, differing in chemical composition (SUR based on esters are known under the brands SUR -PF, SUR -PFL, based on esters – SUR -8, SUR -8P, SUR -7, SUR -7L, SUR -7, SUR -7P).

The classification of ICS according to the methods of their processing into products has been adopted.:

- injection molding (vulcollans) liquid compositions from which products are obtained by combining molding with the synthesis of a solid "crosslinked" polymer – rubber;
- rolled, solid linear or branched products;
- thermoelastomers processed into thermoplastics

SUR is used in mechanical engineering, automotive, aviation, petroleum, coal, and sheet stamping industries for the manufacture of parts and plates, as well as as an anti-corrosion coating that is resistant to abrasive and waterjet wear. Products made of urethane formopolymers are characterized by increased wear resistance, high strength, oil and gas resistance, good shock absorption properties, and resistance to oxygen and ozone.



Fig.1. Urethane rubber products

Urethane rubbers can be divided into 3 types:

Rolled rubbers are solid linear or branched polymers. Rolled SUR rubbers are used to make rubbers with high modulus and hardness, which are used for steering rod liners, sealing cuffs and gaskets.

Low-modulus injection-molded soft low-molecular-weight injection urethane rubbers are used in the printing industry, friction phthulas, parts in the radio engineering industry, as a sealing material in radio electronics, etc.

High-modulus injection molding - high-strength and high-modulus injection molding machines are used as optically active rubbers, for the manufacture of sealing cuffs to cylinders in the automotive and other industries, various diaphragms, brake rollers and gears of silent transmission, wear-resistant coatings. They are used to make screen elements and wear-resistant coatings, parts for various types of cars, etc.

Materials and methods

Technological properties of rubber produced by different vulcanization systems (hydrogen peroxide, dimension hydrogen peroxide) were tested to characterize SUR -8TB_k raw rubber; its resistance to the aggressive conditions was also studied (laboratory samples).

The following properties were used to characterize raw rubber samples SUR -8TB_k based on the xylitane polyether:

1. solubility in the ethyl acetate (State Norms 33034-2014)
2. glass casting temperature (State Norms R 57931-2017)
3. viscosity according to Muni (State Norms R 24552-2011)

Results and discussions

SUR -8TB different raw rubber samples technological properties were studied. The main part

of the raw rubber samples were completely dissolved in the ethyl acetate, this testifies to the fact that it is of linear structure and there are no cross links. Some dissoluble polymer samples were obtained, and this may be explained by the fact that the ratio of some starting components has been changed. SUR -8TB_k raw rubber glass casting temperature is in the limits of -40/-43⁰ C. Comparing SUR -8TB_k with SUR -8PG, glass casting temperature of which is in the limits -34, 5/-35,5⁰C, we may say, that raw rubber SUR -8TB_k has much more low Ts values [5].

The deviations stated are explained by the fact that poly ethers with larger molecular mass were used for the synthesis of these raw rubbers. Ratio viscosity according to Muni was used for the technological evaluation of the raw rubber. It should be noted, that this ratio is in the broad limits depending on the synthesis temperature and correlation of the starting components. We may state that poly urethane SUR -8TB_k (viscosity limits from 20 to 150 conditional units) is easily processed in the cold rolls.

Determination of the processing period influence on the SUR -8TB_k technological characteristics was fulfilled by measuring viscosity value according to Muni at different rolling periods.

Pelt for determining viscosity according to Muni was manufactured in the laboratory rolls of 160 x 320 mm size, friction was 1: 24/ 1, 27; the front roll rotation velocity was 23 – 27,5 revolutions per minute, the gap between the rolls was 1,0 – 0, 05 mm.

Raw rubber was processed in the rolls, where the rolls' temperature was 25⁰ C; the processing period varied from 5 to 20 minutes.

Variations of SUR-8TB_k viscosity according to Muni depending on the processing period at 25⁰ C were investigated.

The curve testifies that if the processing period is increased, viscosity according to Muni is lowered; it may be connected with the partial destruction of the polymer. It was also necessary to clarify the possibility of the SUR -8TB_k raw rubber processing by casting under pressure, because this method turns to be the most productive. This method is possible for using if the viscosity according to Muni ratio is higher than 70 conditional units [6-7].

To achieve this xylitane poly ether P-6 BA (the amount is 1,5 and 10 mass parts) was added to the sample of SUR -8TB_k raw rubber with the starting viscosity according to Muni, equal to 113 conditional units. Data of P-6 BA additives influence on the viscosity according to Muni is given in the table 1.

Table 1 - Influence of xylitane poly ether P-6 BA on the technological properties of SUR -8TB_k raw rubber

Quantity of P-6 BA, introduced into the raw rubber, mass part	Viscosity according to Muni, conditional units
0	131
1, 0	94, 5
5, 0	76, 7
10, 0	70, 7

As it is clear from the table, introduction of 5-10 mass parts of the plasticizer leads to the lowering of the viscosity according to Muni from 131 to 70 conditional units it enables us to use this method with different values of viscosity according to Muni.

Physical – mechanical indexes of the vulcanizers, filled with the xylitane poly ether up to 10 mass part., meet the requirements of the State Norms for the raw rubber SUR -8TB_k.

Conclusion

1. The composition of polyurethane rubber based on polyesters of xylitane SUR -8TB_k, obtained from waste from the hydrolysis and fat-and-oil industry, has been developed.

2. The addition of plasticizer to polyurethane rubber based on xylitane polyesters SUR -8tb reduces the viscosity index according to Muni, which makes it possible to use the injection molding method for processing SUR -8TBk rubber.

3. Polyurethane rubber based on xylitane polyesters SKU-8TBk has good physical and mechanical properties and can be used in various conditions, which significantly expands the scope of application of urethane rubber based on xylitane polyesters.

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КСИЛИТ ПОЛИЭФИРИМЕН МОДИФИКАЦИЯЛАНҒАН УРЕТАНДЫ РЕЗЕҢКЕҢІҢ ТЕХНОЛОГИЯЛЫҚ ҚАСИЕТТЕРІ

Түйін

Ксилитан полиэфиріне негізделген уретанды каучуктарды алу әдісі жасалды. SKU-8ПГ уретанды каучук негізіндегі пероксидті өнеркәсіптік вулканизаттар бөлме температурасында кристалданады, сондықтан бұл каучукты вулканизациялау үшін дамыған кеңістіктік құрылымды құрайтын агенттер қолданылады. Тығыз көлденең құрылымның болуы вулканизациялардың кристалдану жылдамдығын төмендетеді.

Белгілі сополимерлі полиэфирлерге негізделген уретанды каучуктар кристалданбайды және органикалық пероксидтермен, диазоцианаттармен, вулканизация агенттерінің қоспасымен вулканизациялануы мүмкін.

Таңдалған вулканизация жүйесінің сипаты негізінен алынған резеңкелердің қасиеттерін

анықтайды-олардың қаттылығы, модулі, қалдық деформациясы және басқа қасиеттері, сондықтан әртүрлі мақсаттағы бөлшектерді жасау үшін өнеркәсіптік уретан каучук SKU-8ПГ қолданылуы мүмкін. SKU-8ПГ полиуретанындағы метил топтарының едәуір мөлшері кристалдануға және басқа молекулааралық өзара әрекеттесуге кедергі келтіреді. SKU-8 ПГ резеңке негізіндегі резеңкелер жақсы әйнектеу температурасына (T_c) ие, бірақ салыстырмалы түрде төмен серпімділікке ие.

Бұл жұмыстың негізгі міндеті-суыққа төзімділігі мен жоғары икемділігі бар гидролиз және май өнеркәсібінің қалдықтары негізінде алынған ксилитан полиэфирлері (SKU-8ТБк) негізіндегі полиуретанды каучукты синтездеу.

Кілттік сөздер: технологиялық қасиеттері, уретан, резеңке, шыны ауысу температурасы, viscosity, полиэстер, ксилит.

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ТЕХНОЛОГИЧЕСКИЕ СВОЙСТВА УРЕТАНОВОГО КАУЧУКА, МОДИФИЦИРОВАННОГО КСИЛИТАНОВЫМ ПОЛИЭФИРОМ

Аннотация

Разработан способ получения уретановых каучуков на основе полиэфира ксилитана. Перекисные промышленные вулканизаты на основе уретанового каучука SKU-8ПГ кристаллизуются при комнатной температуре, поэтому для вулка-низации этого каучука применяются агенты, образующие более развитую простран-ственную структуру. Наличие плотной поперечной структуры снижает скорость кристал-лизации вулканизатов.

Уретановые каучуки на основе известных сополимерных полиэфиров не кристал-лизуются и могут вулканизоваться органическими перекисями, диазоцианатами, смесью вулканизирующих агентов.

Характер выбранной системы вулканизации в значительной мере определяет свойства полученных резин – их твердость, модуль, остаточную деформацию и другие свойства, поэтому промышленный уретановый каучук SKU-8ПГ может быть применен для изготовления деталей самого различного назначения. Значительное содержание метильных групп в полиуретане SKU-8ПГ препятствует кристаллизации и другим межмолекулярным взаимодействиям. Резины на основе каучука SKU-8ПГ обладают хорошей температурой стеклования (T_c), но сравнительно низкой эластичностью.

Основная задача настоящей работы – это синтез полиуретанового каучука на основе полиэфиров ксилитана (SKU-8ТБк), полученного на основе отходов гидролизной и масложировой промышленности, обладающей морозостойкостью и высокой эластич-ностью.

Ключевые слова: технологические свойства, уретан, каучук, температура стеклования, вязкость, полиэфир, ксилитан.