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ANALYSIS OF MECHANICAL PROPERTIES OF POLYMER MATERIALS USED IN THE AUTOMOTIVE INDUSTRY

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Abstract. Analyzed in the article the method of physical and mechanical properties of automobile bushings made of local polymeric materials.

Keywords: polymeric materials, thermoplast plastics, metal-ceramic materials, carbon materials, polyamides, electrical insulator

Аннотация. В статье анализируется методика определения физико-механических свойств автомобильных втулок, изготовленных из местных полимерных материалов.

Ключевые слова: полимерные материалы, термопласты, металлокерамические материалы, углеродные материалы, полиамиды, электроизолятор

Annotatsiya. Maqolada mahalliy polimer materiallardan tayyorlangan avtomobil vtulkalarining fizik-mexanik xususiyatlarini aniqlash usuli tahlil qilingan.

Kalit so‘zlar: polimer materiallar, termoplastlar, metallokeramik materiallar, uglerodli materiallar, poliamidlar, elektroizolyator

INTRODUCTION.

It is difficult to imagine the constructions of modern vehicles without polymer materials. The use of these materials not only compacts the structures of technical means, reduces their mass, increases performance reliability, but also provides a great way of reducing the cost of production and labor costs. The wide application of polymer materials is caused by the fact that they can directly replace valuable metal and wood materials, in most cases they are superior to them [1].

Polymers are a lot of expensive and rare materials that they can replace, and sometimes even surpass them, caused them to be widely used. Their use is more profitable than economic gist, because the cost per kilo of materials, the cocktail cost of preparing the details is reduced, the details are much lighter, the capital expenditure on storage and operational costs (lubrication, repair) are reduced [2], If the details are made of metal by injection, thermal and mechanical processing, only one of the polymers is obtained by the method of operation, injection or compression under pressure [3]. The waste of material in the preparation of polymer materials does not exceed 5-10%, while in the preparation of metals the waste is much more (60-70%). Products from polymer will be two to three times cheaper than those made of metal [4,5].

METHODOLOGY.

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In this study, a comprehensive experimental and analytical methodology was employed to investigate the physical and mechanical properties of automobile bushings manufactured from locally available polymeric materials, initially selecting various polymer compositions including thermoplastic plastics, polyamides [5], and carbon-based materials, while metal-ceramic materials were also prepared as reference samples for comparative analysis, all specimens were produced under standardized technological conditions using molding, pressing, and machining processes to ensure identical geometric dimensions, subsequently, their physical properties such as density [6], thermal resistance, and electrical insulation characteristics were determined under laboratory conditions using specialized measurement instruments, while mechanical properties were evaluated through compression, tensile [7], bending, and wear resistance tests utilizing universal testing machines and tribological equipment, during the experimental process multiple repeated measurements were conducted for each material to ensure reliability [8], and the obtained data were processed using statistical methods to calculate mean values and dispersion indicators, furthermore, to assess the operational performance of the materials in friction pairs, additional bench tests were carried out under conditions simulating real эксплуатation environments with controlled load and speed regimes, the study also included a comparative analysis of polymeric materials against metal and metal-ceramic counterparts, highlighting advantages such as lower weight, corrosion resistance, and favorable tribological behavior, while also identifying limitations including susceptibility to deformation under high temperatures and heavy mechanical loads, based on the experimental results, practical recommendations were developed regarding the selection and application of suitable materials for automobile bushings, and the feasibility of utilizing locally sourced raw materials was scientifically substantiated, contributing to improved efficiency and cost-effectiveness in automotive component production [9,10].

As is known[11], polymers in relation to metals are distinguished by their elastic module, low heat resistance and low thermal conductivity, high tensile kengayish coefficient, fluidity, tendency to relaxation and other properties.

In the pair of polymer and metal friction, the coefficient of friction is determined mainly by the resistance of the thin curtains formed on the surface to abrasion. If the metal surface of the hook is clean, the polymer will also be less likely to be eaten [12].

In order to increase the resistance of polymers to friction and ingestion at high loading and movement speeds, various fillers are added to their composition. Such additives basically perform the function of pickling, antifriction, heat-

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conducting, heat-resistant, resistant to ingestion. For example, graphite, molybdenum disulfide, talc, oxides of metals, kaolin, phosphagips, Kurim, shishatolasi, asbestos, etc.are used as antifreeze and edible fillers. To increase the thermal and electrical conductivity of polymers, copper, aluminum, bronze, iron, dry, graphite powder and others are used. As fillers, all organic and inorganic substances as well as production and rural farm waste can be used.

The coefficient of friction and the type of filler not only affects the absorption, but also greatly affects its quantity in the composition. To do this, the most optimal quantities of them are determined by experience.

The polymer composition of fillers alokida-alokida is difficult to achieve the necessary properties, so a mixture of several fillers is used. For example, to reduce the coefficient of friction and absorption of epoxy polymer, mixtures of additives such as graphite and talc, fasfogips, graphite and Kurim, asbestos and talc are used in certain quantities.

As an antifricing material, thermoplastic polymers are relatively often used in polyamides. There are other types of polyamide Capron P-66, P-68, caprolone V and so on. They work in harorat from -40 0S to +80 0S (Table 1).

Table 1

Physico-mechanical and friction properties of some polymers and other non steel materials

Materials	Strength limit, kg / cm^2		Operating Temperature ,^{0}C	Friction coefficient
	Siqishda	Cho‘zishda		
Thermosetting plastics	800-1000	-	250-300	**0,10-0,40**
Thermoplast plastics	-	700-800	100-120	**0,15-0,40**
Metal-ceramic materials	2500-2800	-	300-500	**0,25-0,40**
Carbon materials	**200-400**	**140-250**	**300-450**	**0,20-0,35**

The coefficient of friction of polyamide with steel is f = 0.1-0.2 (oil-free), f =0.05-0.1 in oil friction and f = 0.08-0.15 in water friction. If fillers are added to its composition, its properties are improved by 2-3 times. Fluoroplastic and its composition are widely used as antifriction materials in automotive and mechanical engineering. They are resistant to chemicals and resistant to high temperatures (+300 0S and above). There are fluoroplast-2, 2M, 3, 3M, 4 (PTFE), 4M, 4D and other types of fluoroplastics. The coefficient of friction

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of Ftoroplast-4 with steel is as small as that of oil friction. Currently, polyolifins (polyethylene, polypropylene, polystyrene) are also used as antifriction polymers. They are resistant to acids. They are also mainly used as various filler compositions. Their coefficient of friction with metals is in the range f = 0.2-0.4 (Table 2)

Table 2

Coefficient of friction and corrosion of plastics (metal + polymer)

Material	Friction coefficient		Relative corrosion
	static	dynamic	
Polyamides	0,20-0,25	0,25-0,30	**200**
Polypharmaldehyde	0,15	0,20	**65**
Politerofluoroethylene	0,10	0,15	**8**
Polycarbonate	0,30	0,40	**2500**
Polyurethane	**0,30**	**0,40**	**340**

Pentaplast is used in the manufacture of some high-precision machine parts (gears, cuffs, pulleys, etc.). It is resistant to chemicals and is less susceptible towater. Operating temperature 120-130 ^{0}C. The coefficient of of pentaplast with steel is f = 0.12-0.20. Polyfarmaldehyde and epoxy resins are used in the manufacture of many gears, bushings, couplings, etc. They are resistant to organic solvents. Friction coefficient: polyformardehyde and steel f = 0.3-0.35, epoxy and steel f = 0.24-0.3. Polymers are mainly used as thin coatings (Table 3).

Table 3

Friction properties of thin coatings

Plastics	Friction coefficient	Plastics	Friction coefficient
Polyamides	0,04-0,05	Ftoroplast	**0,032**
Polycarbonate	0,032	Epoxy (ED)	**0,032**
Polyacrylate	**0,040**		

CONCLUSION.

Conducted studies have shown that one kg of Har one plastic reduces the mass of the car to 1,2 kg, a decrease in the mass by 10% will help to economy the fuel at the right time up to 20%.

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