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SILICIFIED GRAPHITE AS A PROMISING MATERIAL FOR USE IN A NUMBER OF INDUSTRIES IN OUR COUNTRY

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Abstract
In this paper the physical and mechanical properties and structural features of silicide graphite which obtained from pressed graphite powder absorbed by silicon at high temperatures are given (are present). The results in exploitation were carried out in production conditions.

Keywords: Graphite, material, properties, structure.

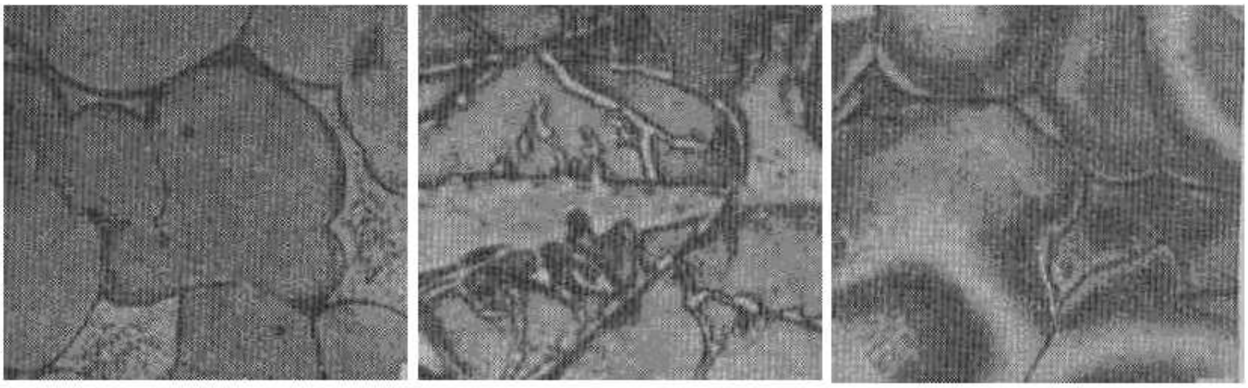
Introduction

Synthesis and development of new materials technologies represent one of the main tasks of modern materials science. At the present time, thanks to progress in fundamental fields of science, especially in solid state physics, the possibilities of obtaining new types of materials with a combination of different properties have dramatically expanded. Impregnation of carbon graphite materials with liquid silicon at high temperatures makes it possible to obtain materials of a new class such as silicified graphite, which has exceptionally high performance properties [1].

The structure of silicified graphite is a rigid frame made of silicon carbide of exceptionally high hardness and free graphite [2], resembling a composite material, which provides a complex of valuable physical and mechanical properties [3].

The Department of Materials Science of TSTU mastered the technology of manufacturing parts for various purposes by impregnating compressed graphite blanks with liquid silicon at temperatures above 2000 ° C. For this purpose, stacks of 10x10 mm in size with a length of 30 mm from fine-grained graphite powder were pressed under various pressures [4]. The impregnation of pressed graphite blanks was carried out in a vacuum furnace at a temperature of 2075 ° C, the impregnation time was 60 minutes.

Microstructural analysis of the stacks after impregnation with liquid silicon showed that the structure of silicified graphite consists mainly of four phases: silicon carbide, free silicon, free graphite and empty pore channels. As the pressing pressure increases, the number of pores decreases significantly, and the material becomes three-phase. Figure 1 shows the microstructure of a stack impregnated with liquid silicon obtained by shooting through the eyepiece of a MIM-7 microscope using a digital camera.



a b c

Fig. 1. Microstructure of a stack of silicified graphite x2000: a - a fragment of the middle of the material; b- pores filled with free silicon; c- particles of free graphite

A number of tests were carried out to compare the mechanical properties of the manufactured stacks with the properties of foreign analogues made of silicified graphite. The results of testing the mechanical properties of the manufactured stacks are shown in Table 1.

Table 1. Physico-mechanical properties of silicified graphite stacks

Manufacturer of the sample material from silicified graphite	Density, g/cm3	Tensile strength, MPa			Impact strength	Modulus of elasticity,	Hardness, HRC
		when compressing	when stretched	when bending			
Department of "Materials Science and Technology of Materials" TSTU	2,65	300	425	95	3,0	95	72
Foreign analog	2,5-2,8	300-320	401-501	90-110	2,8-3,5	95	65-78

The scope of application of parts made of silicified graphite is unlimited, they are used in metallurgy, chemical and petrochemical engineering as friction units (O-rings, bearings, sliding bearings) in pumps, reactors, separators and other equipment; for protective fittings of immersion thermocouples used in measuring the temperature of molten cast iron, copper, zinc and other metals; for locking and filling supplies of metallurgical furnaces and ladles used in casting metal melts.

Materials of high density and fine structure have the highest strength characteristics. Porous and multicomponent materials have lower characteristics due to the presence of pores, silicon and carbon in them. By changing the phase composition and porosity of materials, it is possible to regulate their mechanical properties to a certain extent.

To compare the operational properties of silicified graphite with foreign analogues, end seals in the form of rings made of silicified graphite were manufactured at the department. In Fig. 2 shows the end rings made at the Department of "Materials Science and Technology of Metals" of TSTU.

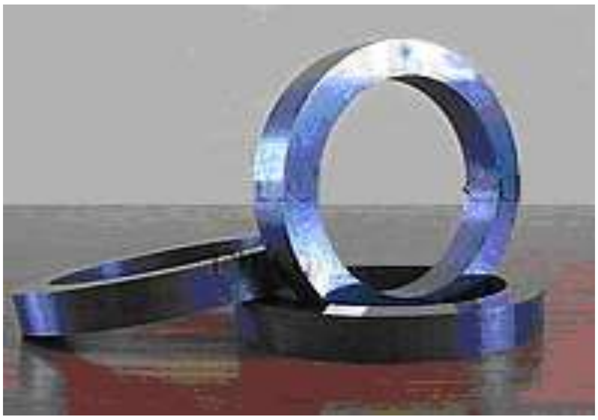


Fig. 2. End rings made of silicified graphite, manufactured by the Department of "Materials Science and Technology of Metals" of TSTU.

Tests of sealing rings were carried out in the operational conditions of the Tashkent Paint and Varnish Plant. To do this, the seals were installed on pumps pumping acidic waters of pigment shop №10. The test results are shown in Table 2.

Table 2. Test results of seals made of silicified graphite

Liquid Properties		Pump numbers, №	Test time, hour	Weight loss, g	The amount of wear, microns
Temperature, °C	The environment, pH				
25-35	3,3-3,8	1	50	0,03	2
		2	100	0,00	no wear
		3	200	0,00	no wear
		4	250	0,00	no wear
		5	500	0,01	0,1

According to the results of tests of sealing rings made of silicified graphite in the operating conditions of the Tashkent Paint and Varnish Plant, it was found that silicified graphite has high wear and erosion resistance, it is stable in acidic environments, has the highest antifriction properties.

The combination of extremely valuable properties of silicified graphite gives reason to recommend them as an antifriction highly wear-resistant structural material suitable for working in friction pairs, including in aggressive environments.

The mastered technology of manufacturing parts from silicified graphite by the Department of Materials Science and Technology of Metals of TSTU can serve for the manufacture of structural parts used in a number of industries of our country.

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