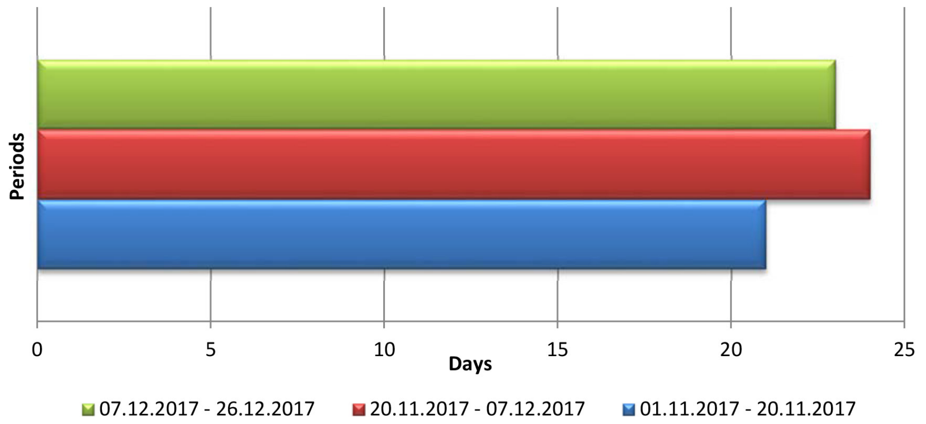

Fig. 2. *Calculated periods between reactor washings*

of washings of reactor tubes is indicated now by the pressure in reactor. This value depends on the amount of high viscosity component accumulated in the tubes.

The calculations of duration of periods between reactor washings were performed on previously developed mathematical model of sulfonation process. The calculations were stopped when the concentration of highly viscous component reached the critical value of 0.034% mass.

As it is seen from figures above, the number of periods reduced, their duration has increased. So, the average duration of periods between reactor washings reaches 17–18 days when the necessity of reactor washing was determined by pressure. When calculations were performed using the predictive ability of mathematical model on highly viscous component accumulation, the average duration of periods between reactor washings grew by 5 days.

It was established that usage of the mathematical model for studying the process allows increasing the duration of periods between reactor washings for film sulfonation reactor and eliminating the risk of obtaining off-test product.

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A STUDY OF MECHANICAL PROPERTIES CERAMICS BASED ON TITANIUM DIBORIDE

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Ultrahigh temperature ceramics (UHTCs) based on titanium diboride has the potential to be used in many technological applications: aircraft industry, mechanical engineering, nuclear energy and metallurgy [1, 2]. The material for ceramics in this work was synthesized by the plasma dynamic method. The ceramics was sintered by a promising spark plasma sintering method, which is characterized by the speed of the process, due to which the grain growth of the microstructure of the sample is

Table 1. The properties of ceramics of titanium diboride

Phase composition, %		Hardness, GPa	Density, %	Nanohardness, GPa	Elastic modulus, GPa
TiB	TiB_2				
66.2	26.8	24.7	75.2	30.992	346.84
21.2	62.1	28.3	85.8	46.695	393.88

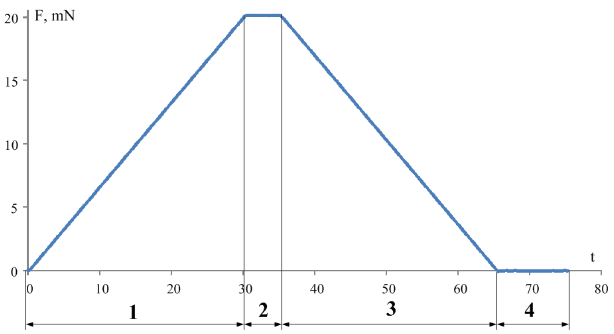

Fig. 1. *Typical test cycle of instrumental indentation*

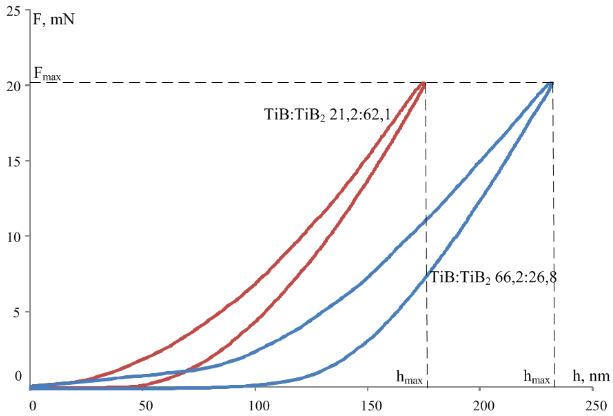

Fig. 2. *Test method (F-h diagram – the dependence of the load on the depth of indentation)*

suppressed.

The sintered ceramics were tested on a Galileo hardness tester and a Table Top Platform (TTX) nanoindentation setup. The properties of ceramics of titanium diboride are presented in table 1.

The hardness and density of the obtained ceramics directly depend on the phase composition of the powder, on the basis of which ceramics were synthesized. The greater percentage of TiB_2 in the phase composition leads to the higher hardness and density of the ceramic sample.

The values of nanohardness and elastic modulus were compared with the literature data: 1) Nanohardness 36 GPa and elastic modulus 360 GPa [3]; 2) Nanohardness 33 GPa and elastic modulus 440 GPa [4]. The obtained values are close to the theoretical values; the nanohardness of the sample with 62.1 % TiB_2 reaches 47 GPa.

Figures 1, 2 show a typical test cycle of instrumental indentation, which shows stages (1 – test load application; 2 – maximum test load; 3 – removal of test load; 4 – test load is 0) and F-h diagram – the dependence of the load on the depth of indentation. As the content of titanium diboride F-h increases, the diagram shifts to the left.

Ceramics based on titanium diboride was obtained by spark plasma sintering method. The hardness, density, nanohardness and elastic modulus of sintered ceramics were investigated. Samples showed high values of measured values comparing to the theoretical data.

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