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# THEORETICAL BASIS AND RESEARCH RESULTS OF MODIFICATION OF TUNGSTEN CARBIDE SOLID ALLOYS

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***Abstract.*** *According to the preliminary results of the experimental tests, it was observed that the hard alloy plates of the VK6R1OM grades with a content of rhenium based on tungsten carbide from 1% to 3%, compared to the wear-resistant VK6 grade, the abrasion resistance increased up to 1.5 times.*
***Key words:*** *tungsten, carbide, hard alloys, cakes, slurry field, tungsten anhydride, ammonium par tungstate.*

***Annotatsiya.*** *Tajriba-sinov natijalarining dastlabki natijalariga ko'ra, volьfram karbidiga asoslangan reniy miqdori 1%dan miqdori 3%gacha bo'lgan VK6R1OM markalarining qattiq qotishma plastinkalari, ishqalanishga bardoshli VK6 markaga nisbatan abraziv yeyilish bardoshliligi 1,5 baravargacha oshgani kuzatildi.*
***Kalit so'zlar:*** *volfram karbidi, qattiq qotishmalar, keklar, volfram angidriti, вольфрамовый ангидрид, volfram amoniy*

***Аннотация.*** *По предварительным результатам экспериментальных испытаний твердосплавные пластины марок ВК6Р1ОМ с содержанием рения от 1% до 3% на основе карбида вольфрама показали повышение стойкости к абразивному износу до 1,5 раз по сравнению с фрикционной маркой ВК6.*
***Ключевые слова:*** *карбид вольфрама, твердые сплавы, кеки, шламовое поле, вольфрамовый ангидрид, паравольфрамат аммония.*

## Introduction

Due to the rational use of natural resources and the sharp reduction of rich ore deposits in the world, there is an ever-increasing demand for efficient use of existing resources and further improvement of existing production capabilities in the mining and metallurgical industry. In this regard, taking into account the direct dependence of the expenses in the production process on the price of the manufactured product, improving the quality of the manufactured products by increasing the working life and productivity of the existing technology and the technological parts considered as its basis (tool, device, tool, etc.) and cost reduction is of particular importance.

## Materials and methods

To date, the demand for low-cost solid alloys with improved performance in various fields, including mechanical engineering, is increasing year by year. Tungsten-cobalt (VK) group hard alloys for material processing are widely used for material processing due to their unique combination of abrasion resistance, strength and heat, as well as a number of other useful properties. The combination of high hardness and durability under high-pressure conditions is essential for the effective operation of the tool in difficult working conditions. Therefore, improving the mechanical and operational properties of the device is the main task for its effective operation in the high temperature range [1-2].

The scientific significance of the research results is based on the methods of modification of hard alloys of the VK group with rhenium, the mechanism and technological scheme of modification of alloyed carbide phase with rhenium based on the new WC-ReC-Co system of hard alloys by determining the laws of friction with minerals, depending on the type and composition of the sample alloy and technological factors. is explained by being invited.

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The practical significance of the research results is that the abrasive wear resistance of the finger obtained from a hard alloy with a new chemical composition and abrasion resistance is increased compared to the original one, SEMSO reduces downtime for current maintenance due to the extended service life of grinding fingers, the creation of optimal technology for pressing and heating hard alloys that are resistant to corrosion.

The sequence of the process of obtaining superalloys:

1. Obtaining carbide and Co powders by oxidation-reduction method.
2. Grinding carbide and cobalt powders to 1-2 microns (performed in ball mills for 2-3 days).
3. Sieve and grind again if necessary.
4. Preparation of the mixture (the powder is mixed in an amount corresponding to the chemical composition of the alloy being produced).
5. Cold pressing (an organic binder such as alcohol, paraffin or glycerin is added to the mixture to temporarily maintain its shape).
6. Burning under pressure at 1400°C, at 800-850°C the organic binder burns completely. At 1400°C, Co melts and wets carbide powders, and during subsequent cooling, Co crystallizes through bonding of carbide particles [6; 1-520 pp.].

In materials with and without Co, this led to early reduction of W-oxides and the formation of Cr-based oxides, which altered the chemical processes during heating and grain growth behavior. The influence of Co and inhibitors on the chemical processes occurring during the heating process was studied by FE-SEM and XRD methods [3,4,6].

In order to inhibit the grain growth of WC-Co, alloying with transition metal carbides is common. The effectiveness of such inhibitors was compared at low eutectic temperatures, in the absence of a binder phase, and in alternative binder systems to cobalt. Their influence on the mechanical properties of WC-Co hard alloy was considered.

## Results

In order to inhibit the grain growth of WC-Co, alloying with transition metal carbides is common. The effectiveness of such inhibitors was compared at low eutectic temperatures, in the absence of a binder phase, and in alternative binder systems to cobalt [7]. Their influence on the mechanical properties of WC-Co hard alloy was considered. And ligature helps to reduce the size of grains. Among the hard alloys, VK alloys have smaller grain structures than those with the same content of Co, have higher impact toughness and the highest bending strength. By alloying the solid alloy and removing impurities from the raw material to produce it in the formation of the structure of the solid alloy it is important to achieve the minimum grain size [9-12].

Processing of tungsten raw materials is carried out in autoclaves at high temperature and high pressure, and sodium tungstate solution is obtained. After purification from impurities, less soluble $H_2WO_4$, $CaWO_4$ or tungstate ions are separated by ion exchange. Compounds in shelties concentrate - silicon, phosphorus, arsenic, molybdenum, base metal tungsten and other compounds form soluble sodium salts $Na_2SiO_3$, $Na_8PO_4$, $Na_2AsO_4$, $Na_2MoO_4$, $Na_2WO_4$ during alkalizing at high temperature, and calcium carbonate ($CaCO_3$) salt formed during alkalizing precipitates. The following chemical reactions occur in the process of alkalization:

$CaWO_4 + Na_2CO_3 = Na_2WO_4 + CaCO_3$
$SiO_2 + Na_2CO_3 = Na_2SiO_3 + CO_2$
$Ca_3(PO_4)_2 + 3Na_2CO_3 = Na_3AsO_3 + CaCO_3$
$As_2O_3 + 3Na_3CO_3 = 2Na_3AsO_3$
$As_2O_3 + 3Na_3CO_3 + H_2O = 2Na_2HAsO_3 + 2CO_2$
$CaMoO_4 + Na_2CO_3 = Na_2MoO_4 + CaCO_3$

When decomposing tungsten concentrates using acids ($HNO_3$, HCl), tungstic acid ($H_2WO_4$) is formed in the solution and precipitates. Si, P, As impurities form heterophony tungstate's in acidic solutions, making it difficult to precipitate tungstic acid and causing partial loss of the base metal.

During the experimental work, it were found that the proportional change of the abrasive curvature of the samples in relation to the impact speed up to the critical point and after this point a sharp change in the size of the abrasive curvature could occur:

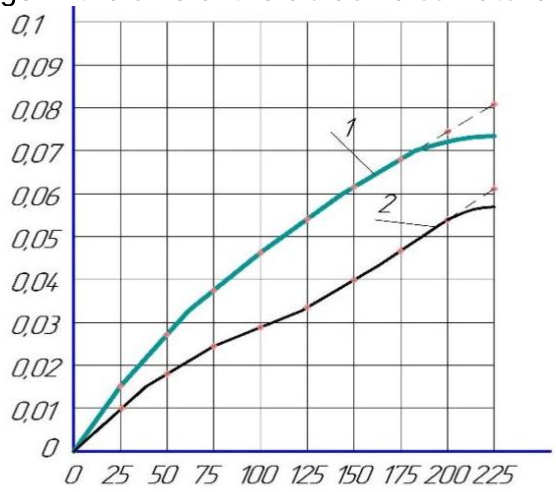


**Fig.1. 1– bending of the "OUEOT" pile of the VK6 sample as a result of the impact of ore flow; 2 – Corrosion of the VK6 sample as a result of the impact of the ore flow of the "Muruntau" mine.**

A change in the size of the abrasive bodies also led to a change in the abrasive wear of hard samples [13-14]. In the process of friction of abrasive bodies with the sample, the use of wet abrasive particles also changes the area of abrasive bending and the impact angle of the particles [15-17] (Figure 1). If m is constant, the intensity of abrasive wear of the samples will not change. Determining and analyzing the influence of the size of the initial abrasive particles on the abrasive wear of hard alloy samples, it was confirmed that the increase in the size of the abrasive particles in the range of 0...200 μm increases the intensity of the abrasive wear.

By increasing the service life of each finger, the cost of purchasing polished fingers of VK-6 alloy with high strength is reduced. By increasing the average working life of each finger by at least 30-40%, it is planned to reduce the annual demand to 700 fingers and bring it to 2100 pieces per year.

Each high-strength VK-6 alloy finger is expected to have a life of at least 140 hours, reducing maintenance and repair costs for impact crushers

The next stage of experimental work is aimed at "Looking for solutions to reduce the intensity of abrasive wear in an abrasive wear environment and to improve the properties (chemical composition, hardness, processing) of the fingers

As a result, modern methods of physico-chemical analysis scientifically substantiated the use of GOST 3882-74 in improving the chemical composition, hardness, processing characteristics to increase the friction resistance parameter of VK-6 hard alloy fingers

## Conclusion

Compared with imported analogues, the reason for the decrease in the wear resistance of VK hard alloy is due to the defect in its structure, that is, the grain size of tungsten carbide is responsible for the wear resistance and hardness, and its nano-size provides an increase in these indicators. The nanostructure is achieved by inhibiting the growth of WC grains, for example, by introducing 1% rhenium carbide into the alloy.

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