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STUDY OF THE PROPERTIES OF THE H13A CARBIDE PLATE (ANALOGUE VK6OM) AFTER COMPREHENSIVE PROCESSING IN CUTTING STEEL 18XGT

***Abstract**: This article examines the properties of the H13A carbide plate after complex processing when cutting steel 18XGT. As already noted, wear spots on a carbide cutting tool can be located on all working surfaces. And the location of the prevailing source of wear, which develops in the place where the maximum temperature operates, determines the processing conditions. A significant part of the frictional energy of the tool is converted into heat. and high-temperature alloys have low thermal conductivity.*

***Key words**: roughness, wear, deformation, cutting force, wear resistance, surface, depth, processing.*
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Introduction

The state of the surface layer of the workpiece and the roughness of its surface are significantly influenced by the result of the force aftereffect of the transformation of the cut allowance into chips, as a result of which a transitional plastically deformed layer arises, which is determined by the processes of self-adapting tribocontacts, which is responsible for the formation of a stagnant zone and build-up. The process captures the chip formation zone and tribocontacts of the working surfaces of the cutter with the chips and the surface that is being processed. Deformations reach depths from several micrometers to hundredths of a millimeter. The intensity and depth of the spread of work hardening increases with an increase in cutting forces and the duration of their impact.

The magnitude of the cutting force affects the change in dimensions due to the displacement of the workpiece to be processed relative to the centers of the machine, the intensity of abrasion of the contact areas of the cutting plate, the magnitude of internal stresses, which often leads to leads and changes in the dimensions of the workpieces. The studies carried out on the wear of replaceable multi-faceted N13A plates in the turning operation of steel 18XGT showed that electron-beam alloying in combination with the coating reduces the cutting force, changes the location of the tool wear zone and affects the intensity of its wear (Fig. 1).

When cutting with a tool without machining, the characteristic place of occurrence of wear is the top of the insert (Fig. 1, a, b).

For tools with a wear-resistant coating and complex machining, blocking of the development of wear at the tip is observed, which significantly slows down the onset of the stage of catastrophic wear (Fig. 1, c-f). This can be attributed to the fact that the near-surface modified layer obtained by means of complex processing exhibits chemical passivity and reduces the adhesive interaction with the processed material. TiNb and Hf carbides form stable and strong oxides. As a result, the characteristics of contact processes change, which significantly reduces the power of the heat generation source near the cutting wedge of the tool.

It follows from Fig. 1 that, in addition to blocking the wear of the cutter at the tip, there is also a decrease in the intensity of wear along the flank surface. It is known that a gradual increase in temperature in the zone of direct contact leads to catastrophic wear along the flank surface, which eventually reaches values at which irreversible processes begin in a hard alloy. The delayed flank wear on a multi-cut tool can be explained by the fact that the near-surface layer created under the coating has increased hardness combined with higher heat resistance and better resists microplastic deformation. This, apparently, also inhibits the softening processes at the back surface.

This is the difference in flank wear on a multi-cut tool and wear on a coated tool only. In the case of a coated tool without microalloying, after exposure of the base, the friction conditions on the flank surface are increasingly approaching those characteristics of an uncoated tool.

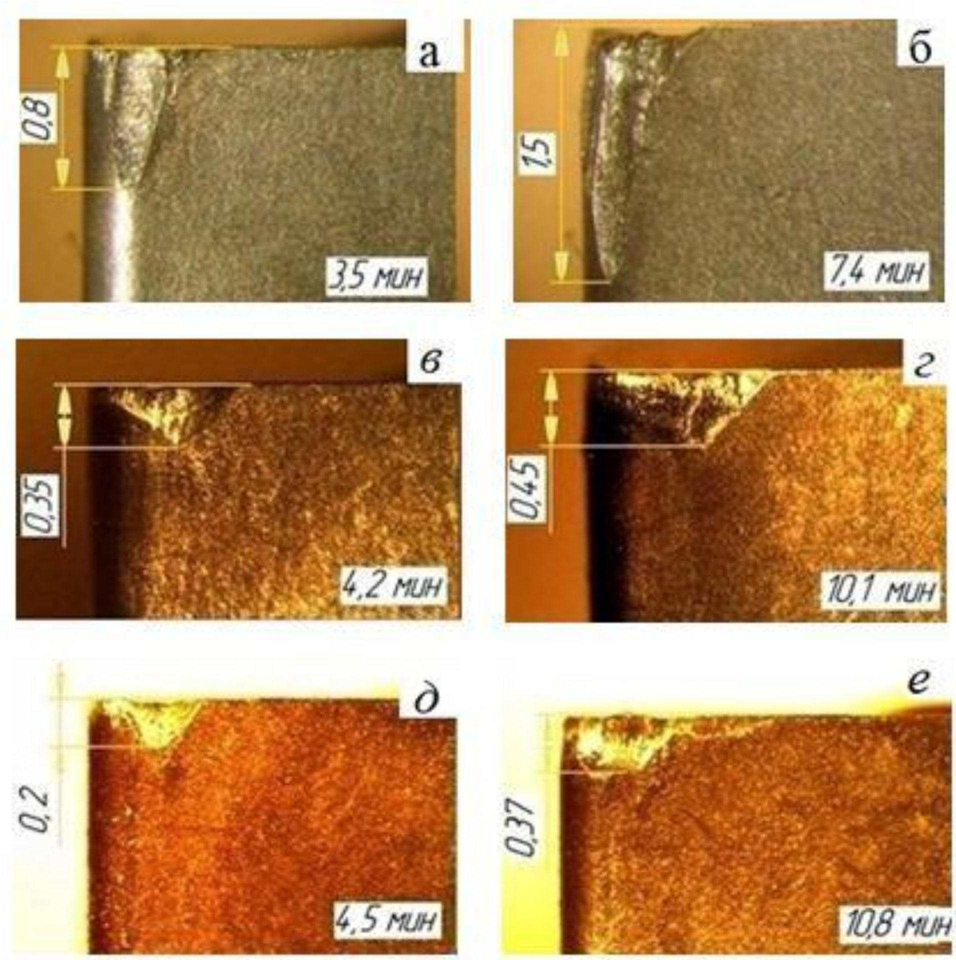
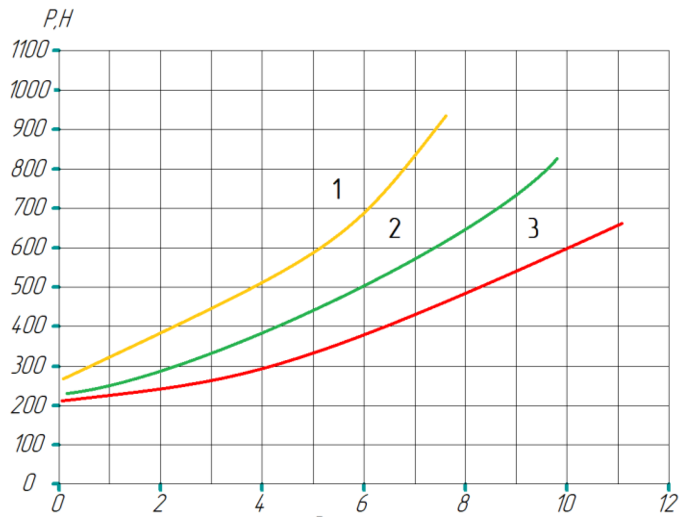


Fig. 1. Wear of cutting plates H13A during turning of heat-resistant alloy; a - b) uncoated plate; c-d) coated plate; e - f) plate after complex processing.

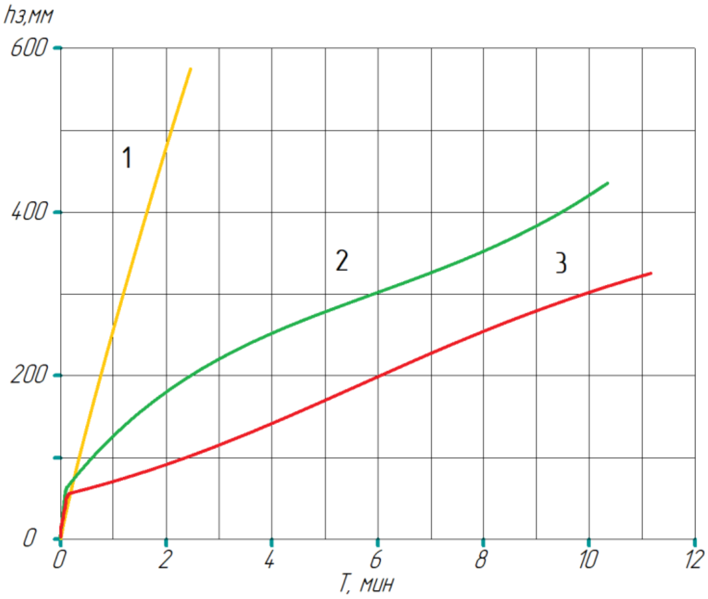
In a tool with complex processing, even after a breakthrough of the coating, the modified layer continues to perform its protective functions, which is reflected in the wear pattern of the tool (Fig. 1, d, f). Complex machining noticeably inhibits the formation of a wear pocket on the front surface. The wear zone on such inserts is closer to the tip of the tool than for inserts with only a wear-resistant coating, but at the same time, wear does not develop along the tip of the insert.

In practice, the durability of a metal-cutting tool is determined by the amount of wear on the flank surface (for finishing operations, it is considered critical that its value is of the order of 0.3-0.4 mm, for roughing operations - 0.4-0.8 mm). Often, this criterion is not always the most objective, since wear can be of a different nature, which is just characteristic of the case under consideration.

Therefore, as criteria for assessing the wear resistance of N13A plates when cutting a heat-resistant alloy, in addition to the amount of wear on the flank surface, the change in the resultant cutting force during processing was also considered (Fig. 2).



a



b

Fig. 2. a) the dependence of the magnitude of the resultant cutting force on time; b) time dependence of the wear of the cutting insert along the flank surface.

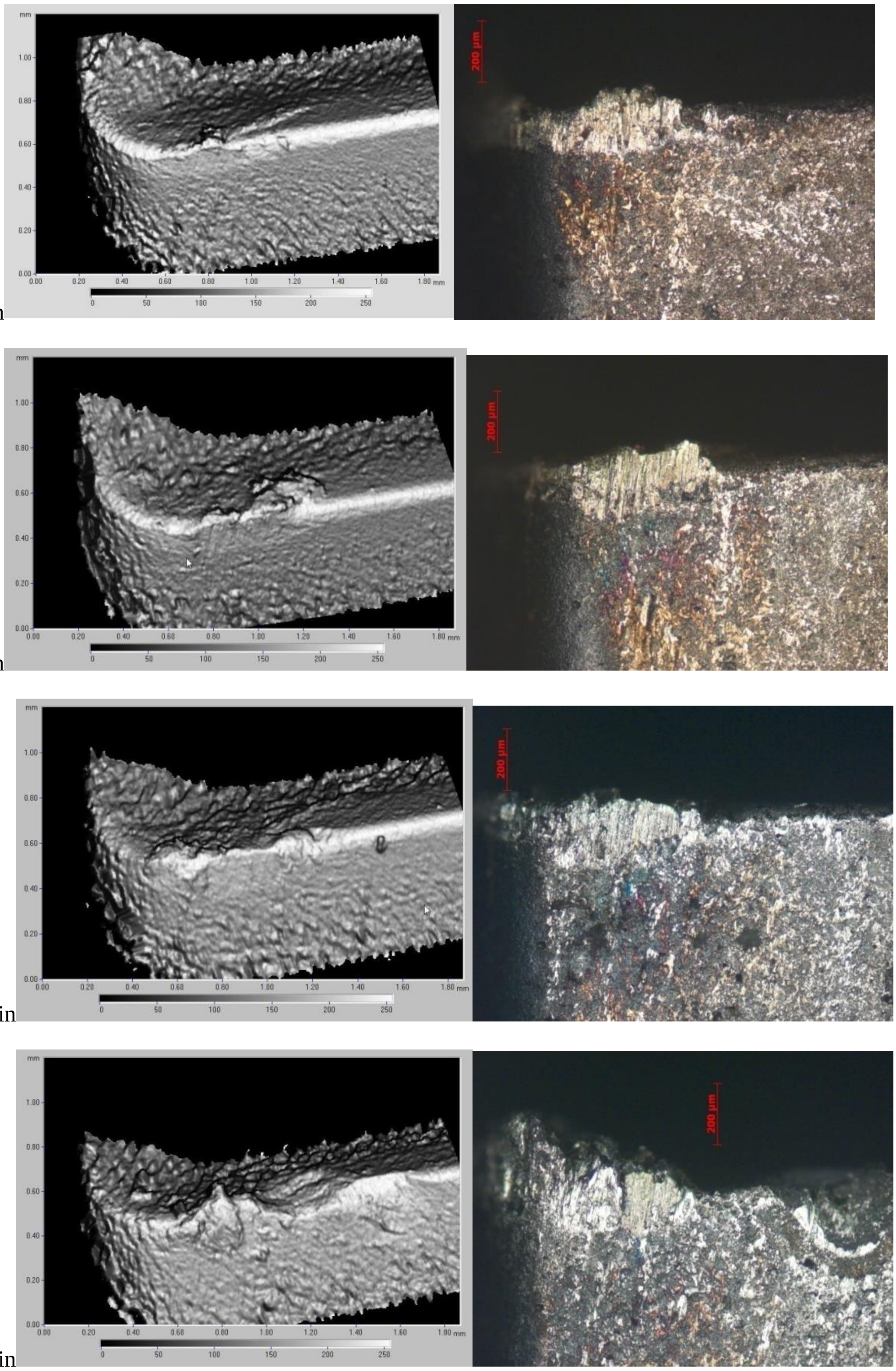
Based on the resistance tests of a removable multifaceted insert, we can conclude: The increase in the life of the insert after complex processing, including alloying with NESP and subsequent coating (TiAl) N according to the criterion of cutting forces, was up to 100% compared to inserts without treatment and up to 75% in comparison with plates only with a wear-resistant coating (Fig. 2, a). The increase in resistance according to the criterion of the amount of wear on the flank surface was about 400-500% compared to plates without treatment and up to 40% compared to plates with only a wear-resistant coating (Fig. 2, b).

In order to study in more detail, the difference in the wear of the flank of a tool with a complex treatment from tool wear only with a coating, a series of experiments was carried out on cutting 18XGT steel.

In fig. 3 and 4, a study of the process of wear of the section of the H13A plate adjacent to the active section of the cutting edge is provided using an optical 3D scanner.

Attention is drawn to the different nature of the formation of adhesions and build-up on the cutting edge, which indicates a change in the chip formation process after microalloying the tool surface. A change in the structure and phase composition of the material of the cutter leads to a shift in the adhesion zone of the processed material closer to the top of the cutter. In this case, the section of the cutting edge that is not in operation is often damaged by the coming off shavings. To avoid this phenomenon, it seems necessary to slightly change the geometry of the insert, adapting it to changing cutting conditions.

It was found that the formation of chips outside the working area does not greatly affect the roughness of the treated surface. For the given cutting conditions, the roughness was determined rather by the individual properties of the plate than by the mode of its processing. The spread of RA values from plate to plate ranged from 1.6 to 3.5 μm.



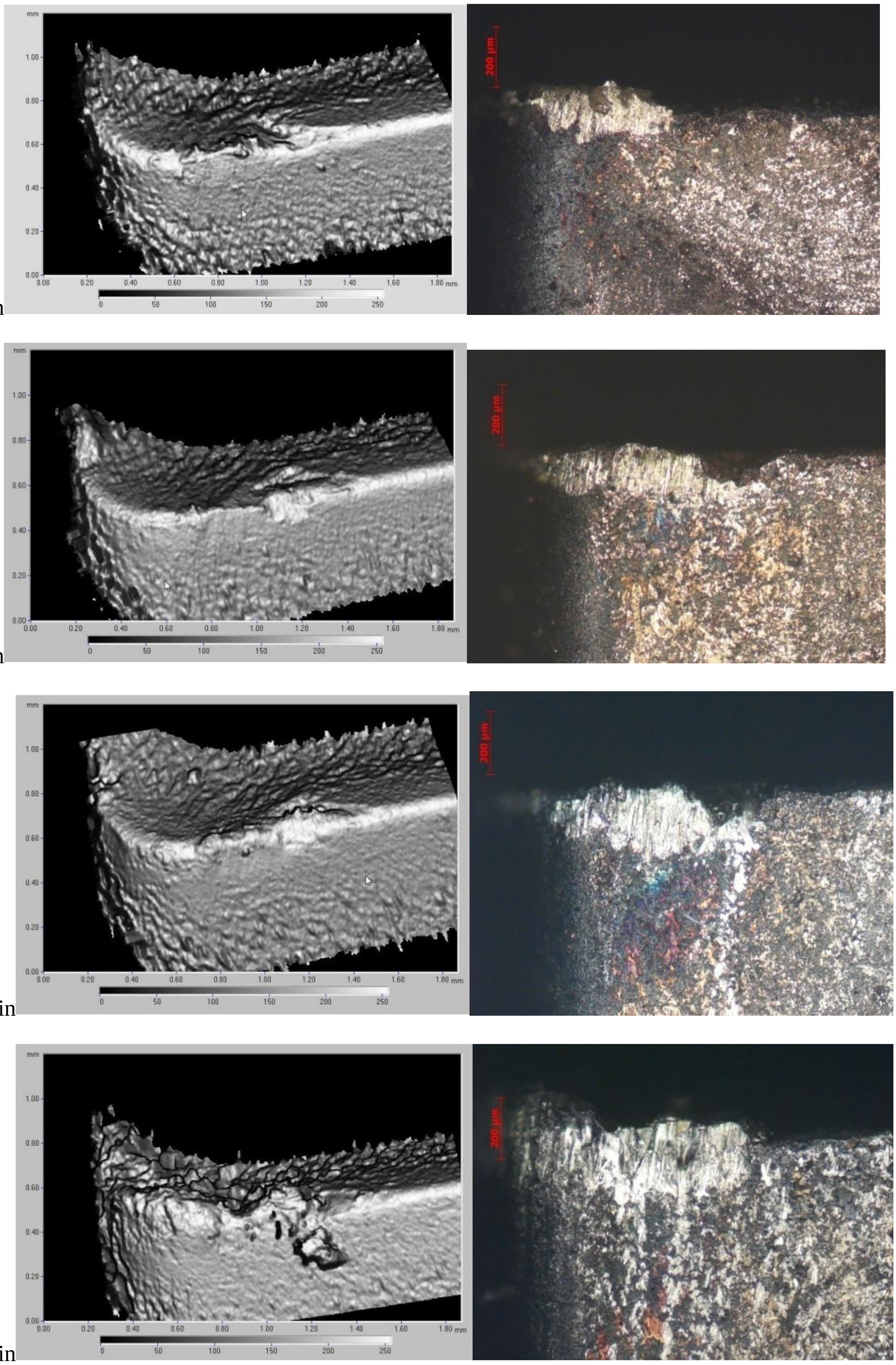
2 min

8 min

14 min

18 min

Fig. 3. 3D scans of the cutting edge area and a photo of the rear surface of worn H13A plates with (TiAl) N coating when cutting 18KhGT steel; v = 110 m / min, t = 0.25 mm, s = 0.15 mm.



2 min

8 min

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18 min

Fig. 4. 3D scans of the cutting edge area and a photo of the rear surface of worn H13A plates with microalloying with NbHfTi alloy and (TiAl) N coating when cutting 18XGT steel; v = 110 m / min, t = 0.25 mm, s = 0.15 mm.

Nevertheless, a number of features of the work of plates with a complex surface treatment can be distinguished. So, the running-in of such plates is faster, and the roughness values remain stable longer (Fig. 4).

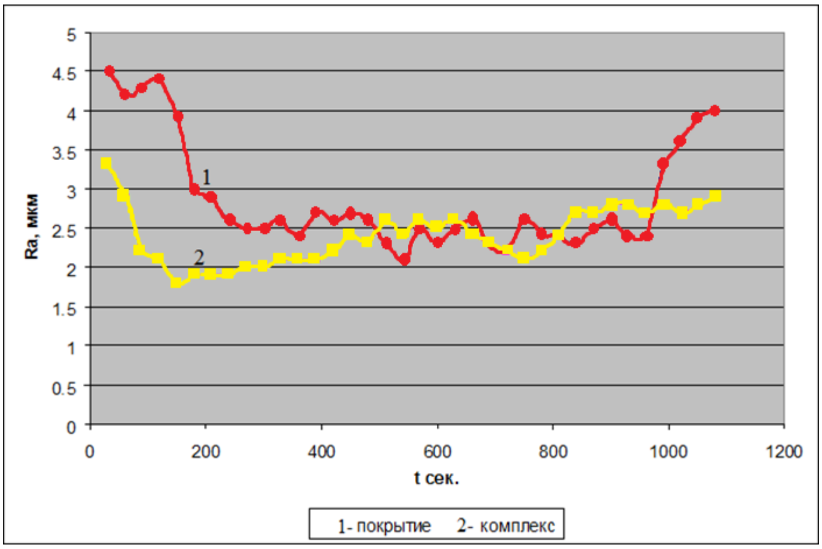
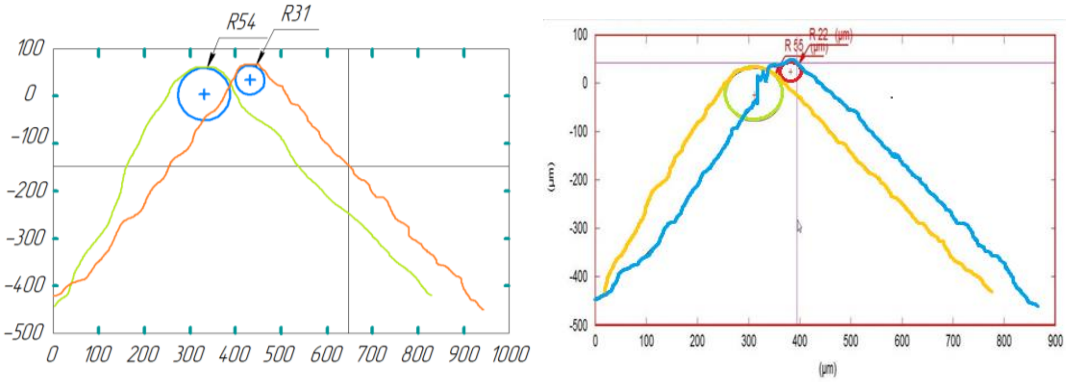


Fig. 5. Change in the surface roughness of the workpiece when cutting 18KhGT steel with N13A plates with a wear-resistant coating and with complex processing (v = 110 m / min, t = 0.25 mm, s = 0.15 mm).



a b

Fig. 6. Change in the radius of rounding of the cutting edge ρ after the insert has run in for 4 minutes. (3D scanner GFM); a) - plate with (TiAl) N coating, b) - plate with complex processing. The graphs also show the cutting-edge radius of the original insert.

Another feature of the wear of N13A plates after complex processing is a change in the place of formation of a wear hole - moving it closer to the radius of the tool. It should be noted that the radius of rounding of the cutting edge, formed during the interaction of the processed and producing surfaces, in the case of microalloying is noticeably smaller (Fig. 6). It is possible that, among other things, this is associated with a significant drop in the cutting force.

Conclusions

The durability of N13A plates with complex processing when cutting 18XGT steel after carburizing according to the criterion of cutting forces was up to 100% compared to the original plates without treatment and up to 75% compared to plates with only a wear-resistant coating. The increase in resistance according to the criterion of the amount of wear on the flank surface was about 400-500% compared to plates without processing and up to 40% compared to plates with only a wear-resistant coating. There is a shift in the wear zone and the tip of the cutter and a decrease in the radius of the cutting-edge rounding ρ after running in the cutter.

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