ISSN: 2350-0328

International Journal of Advanced Research in Science, Engineering and Technology

Vol. 8, Issue 9 , September 2021

Investigation of Deformation-Thermal Processes in the Structural Adaptability of the Tool

Mardonov Bakhtiyor Teshaevich, Ravshanov Jamshid Ravshanovich

Doctor of Technical Sciences, Professor, Navoi State Mining Institute
Senior Lecturer, Navoi State Mining Institute

ABSTRACT: This article presents the results of studies of deformation-thermal processes in the structural adaptability of the tool, the implementation of the running-in of the tool by analogy with the rolling-in friction units of machines, which is one of the most effective and mandatory ways of increasing the working capacity.

KEYWORDS: tool, microhardness, running-in, structural adaptability, deformation, hardening, durability.

1. INTRODUCTION

In the conditions of independence and reforming the economy of Uzbekistan, one of the key tasks is to improve innovation and the practical use of scientific and technological achievements that ensure the competitiveness of products in the world market. Today, an innovative breakthrough strategy is being developed in Uzbekistan. Specific steps to implement and activate the innovation program were made with the adoption of the Strategy for industrial and innovative development of the Republic of Uzbekistan until 2026. it is closely related to mechanical engineering and the metalworking industry - one of the priority areas of the strategy. The successful development of each production largely depends on the extent to which it is provided with the proper quality of tools, equipment, etc. Practice shows how important metal-cutting tools are for modern mechanical engineering.

II. MATERIAL AND METHODS

The formation of secondary structures on the working surfaces of the tool is one of the manifestations of a fundamental pattern - self-organization. The optimal variant of self-organization or structural adaptability is the process of formation of secondary contact structures with strength properties that significantly exceed the initial one. This phenomenon is the result of complex physicochemical processes initiated by plastic deformation and accompanying friction during cutting, and manifests itself in a relatively narrow framework of the functioning of frictional contact. The properties of secondary structures are determined by two simultaneously acting competing factors: hardening and softening, or, equivalently, strain hardening and thermal rest.

Structural adaptability in the applied version is successfully used in the practice of operating friction pairs and is realized due to their running-in or running-in. The fundamental regularities of friction pair rolling are also applicable to cutting tools, the preliminary running-in of which at cutting conditions, optimal from the point of view of hardening their working surfaces, can be considered as an effective and one of the cheapest ways to increase durability.

The depth of the transformed structure of the working surface of the tool is a thin layer with a thickness of several tens of micrometers, which seriously complicates the study of its strength properties. One of the available and widely used methods of mechanical testing is the measurement of microhardness on specimens of the "oblique thin sections" type, which convincingly confirms the very fact of the presence of structural adaptability and allows a rough estimate of the degree of hardening and the depth of occurrence of the modified layer. The amount of hardening and its depth is determined by both cutting conditions and the nature of the contact process.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 8, Issue 9 , September 2021

III. SIMULATION & RESULTS

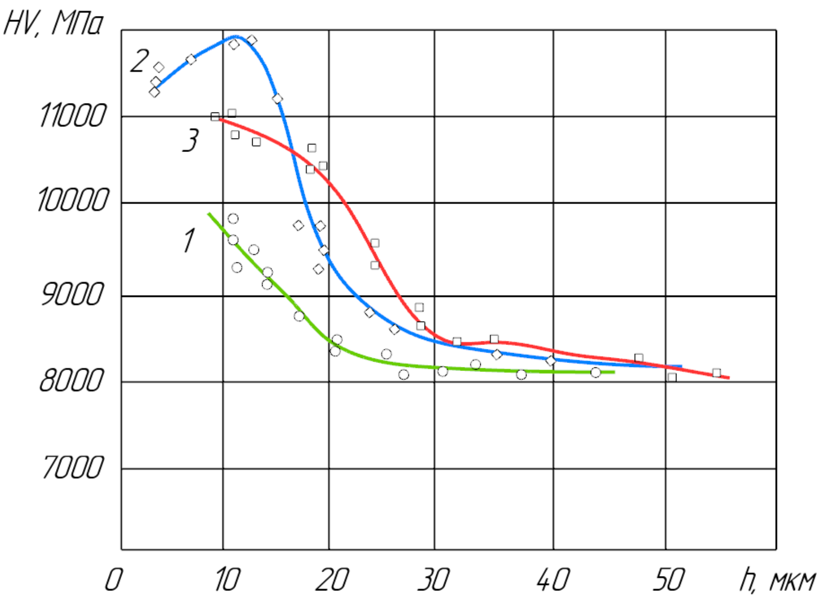

Fig. 1. Distribution of microhardness in the contact layer of cutters made of P6M5 during turning of 40X steel (S = 0.2mm / rev; t = 0.5mm).

1- in the original state (after hardening)
2- after 10 minutes of turning at V = 0.583 m / s
3- after 10 minutes of turning at V = 0.833 m / s

Figure 1. the curves of the distribution of microhardness in the contact layers of the tool in the initial state obtained by grinding (curve 1) and after short-term cutting in different modes (curves 2 and 3) are presented. The nature of changes in microhardness in depth has a typical form, similar to those in the surface layers of hardened machine parts, and the thickness of the transformed structure is on average 30 ... 50 µm. Figure 2 shows similar dependences obtained in the study of the hardening of the teeth of a worm cutter according to R6M5 when milling gears with m = 10 mm. The nature of the location of the curves is fundamentally preserved in comparison with Fig. 1., however, the value of hardening is significantly higher on average by 10 ... 15%, and the depth of the modified layer reaches average values within 40 ... 60 µm, which is 10 ... 30% higher than those obtained at turning. This numerical difference can be explained by the presence of shock processes accompanying milling and periodic thermal cycling on the contact pads of the cutting teeth. Turning with imitation of shock processes when cutting a cylindrical roller with a pre-milled groove confirms this assumption. In fig. 3 shows the distribution of microhardness in the contact corresponding to the experimental value of Fig. 1. The obtained values of hardening and depths of occurrence are numerically close and the result of the analysis of hob cutters, i.e. higher than with smooth turning.

And so, the amount of hardening depends on the cutting conditions and becomes more important in the presence of shock processes. However, the large value of the scatter and the insignificant numerical difference in their average static values makes it difficult to perform a serious quantitative analysis to establish the relationship between the parameters of cutting and contact interaction with the degree of hardening of secondary structures.

Taking into account the foregoing, one of the objectives and sufficiently informative methods for analyzing the properties of the secondary structures of a tool is to determine its wear resistance at cutting conditions exceeding those at which its formation took place. The methodology for such an analysis is as follows. Secondary structures, as transformed from the original ones, formed in the contact process during short cutting (for example, within 10 minutes) under various operating conditions, are further tested for wear at higher, fixed for each experiment, modes. In this case, the nature of wear and the parameters of tool life will be largely determined by the conditions of contact interaction of the initial cutting process, in which the formation of secondary structures was realized.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 8, Issue 9 , September 2021

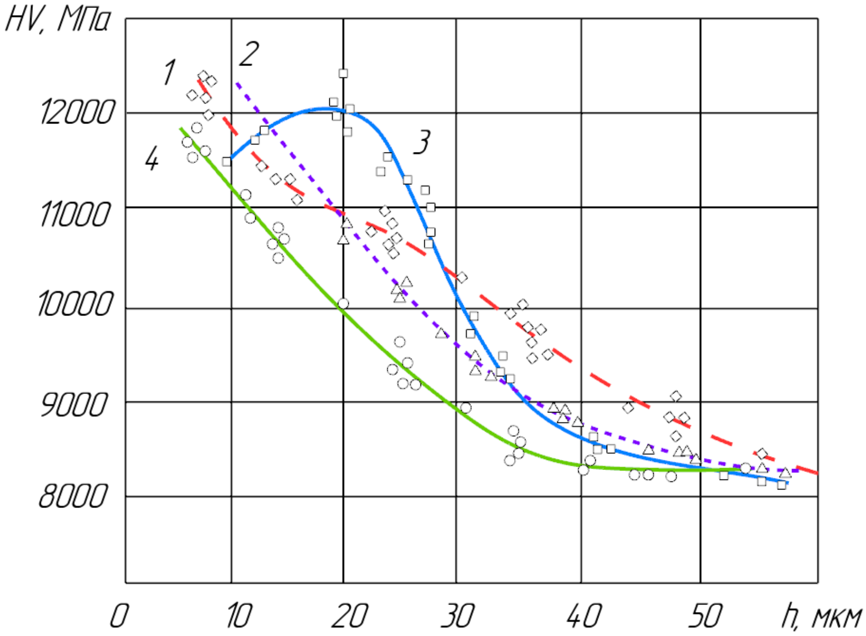

Fig. 2. Distribution of microhardness in the contact layer of a worm cutter m = 10 mm from R6M5F when processing cylindrical gears from steel 40X.

1 - in the initial position (after hardening)
2 - after 15 minutes of work at V = 0.541 m / s
3 - after 15 minutes of work at V = 0.7 m / s
4 - after 15 minutes of work at V = 0.833 m / s

It can be assumed that the initial cutting (or preliminary running-in) regimes corresponding to the maximum tool life will determine the conditions of contact interaction, under which the formation of the most wear-resistant, and, therefore, more hardened structure is stimulated. As can be seen from the description, the technique largely uses the idea of preliminary running-in, but is considered not as a method of increasing resistance, but as a methodological technique for analyzing the state of the transformed surface structure.

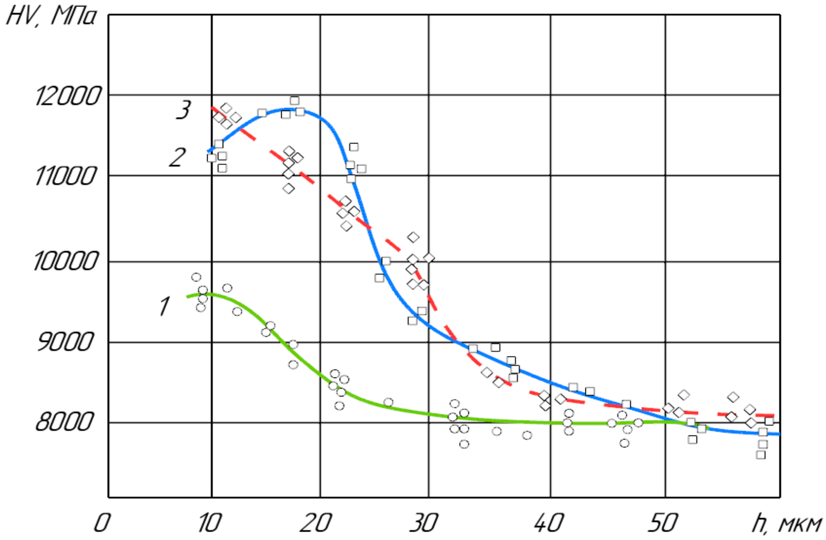

Fig. 3. Distribution of microhardness in the contact layer of cutters made of R6M5F during turning of 40X steel with shock loads.

ISSN: 2350-0328
International Journal of Advanced Research in Science, Engineering and Technology
Vol. 8, Issue 9 , September 2021

S = 0.2 mm / rev; t = 0.5 mm:
1 - in the initial state (after hardening);
2 - after 10 minutes of cutting at V = 0.583 m / s;
3 - after 10 minutes of cutting at V = 0.833 m / s.

IV. CONCLUSION

1. Based on the foregoing, the following conclusions can be drawn:
2. In the mechanism of increasing the wear resistance of the working surfaces of the tool by running-in, the dominant role is played by the processes of strain hardening, the manifestation of which is an increase in their microhardness and the density of defects in the crystal structure.

REFERENCES

1. Kremnev L.S., Sinopalnikov V.A. Changing the structure and properties in the cutting part of high-speed steel tools in the process of continuous turning. // Bulletin of mechanical engineering, 1974. No. 5 p. 63 ... 67.
2. Kim V.A., Yakubov F.Ya. The influence of hardness on the tribotechnical properties of the cutting tool. Theses of the report of the VII All-Union Symposium on Mechanoemission and Mechanochemistry of Solids. Tashkent, 1979, p. 130..131.
3. Starkov V.K. Dislocation concepts of metal cutting. - M .: Mashinostroenie, 1979.160 p.
4. FridmanYa.B. Mechanical properties of metals. Deformation and destruction. - M .: Mashinostroenie, 1974.472 p.
5. Askinazi B.M. Strengthening and restoration of machine parts by electromechanical processing. Z. ed. Revised and add. - M .: Mashinostroenie, 1989.200 s.