UDC 621.745

Methods for increasing the wear resistance of cutting tools

E.O. Umarov[1], U.T. Mardonov[2]

[1]*Professor, DSc. at Tashkent state technical university, Uzbekistan.*
E-mail: red_engineer94@mail.ru
[2]*Ph.D. student at Tashkent state technical university, Uzbekistan.*
E-mail: umid.mardonov@tdtu.uz

Abstract

In this paper, methods of increasing the wear resistance of cutting tools which is widely used in manufacturing are analyzed. A lot of researches which have been done are studied and the most suitable ones for manufacturing of Uzbekistan are chosen. Authors especially payed attention to Chemical-thermal methods, Coating the tool material, the method of chemical vapor deposition, Vacuum-plasma methods.

Keywords: Cutting tool, Cutting process, manufacture, tool materials, CNC machines

Currently, there are increased requirements for the cutting properties of tools, especially tools for CNC machines and flexible manufacturing complexes. Traditional methods of increasing the tool life by means of complex alloying have almost exhausted their possibilities. In this regard, methods for increasing wear resistance have been developed and implemented, based on the creation of thin surface layers with specified properties on the working edges of tools. The most widespread among them are chemical heat treatment and the application of wear-resistant coatings.

Chemical-thermal methods (cyanidation, nitriding or nitrocarburizing, boriding, etc.) are types of processing in which there is a change in the chemical composition and properties of the surface layers of tools made of steel. These changes are achieved as a result of the diffusion of various elements from the external environment into the steel. Among the methods listed above, the most widely used is cyanide, that is, saturation of the surface layer of the instrument with carbon and nitrogen at the same time. Cyanide treatment is carried out after heat treatment and final sharpening. After cyanidation, a layer with a thickness of 20 ... 30 microns is obtained, which has a high hardness up to 70 HRC, as well as heat resistance and wear resistance. The cyanide layer has a lower coefficient of friction with the processed material. As a result, the durability of cyanide instruments increases 1.5 ... 2 times.

Coating the tool material makes it possible to create a new set of properties on its surface while maintaining the necessary properties of the base. This direction of increasing tool life is currently the most important. There are a large number of methods for obtaining coatings on the working surfaces of cutting tools. Among

them, the following methods are widely used: chemical deposition of coatings from the vapor-gas phase and vacuum-plasma.

The method of chemical vapor deposition (called GT) is based on the condensation of gaseous compounds with the formation of solid precipitates. At the same time, the temperature of the substrate (tool) is high (1000 ... 1100 ° C), i.e. the method is high-temperature and is applicable only for applying coatings on a hard alloy tool. This method applies coatings to multi-faceted carbide plates. More than half of multi-faceted inserts are currently available with wear resistant coatings. Coating materials are: TiC; TiN, TiCN; ZrN; HfC; MoC: MoN; CrN; TaN, etc.

Vacuum-plasma methods (ICB method - condensation of coatings from the plasma phase in vacuum with ion bombardment of the instrument surface; REB method - reactive electron-beam plasma deposition of coatings in vacuum) have wider technological capabilities. The temperature of the substrate in these methods is rather low (~ 450 ° C), i.e., the methods can be used for coating both hard alloys and high-speed steels. Currently, many domestic enterprises have created areas for applying coatings by the ICB method, equipped with installations of the "Bulat" type. They can be coated on plates and axial tools (drills, taps, countersinks, reamers, etc.). The optimum coating thickness is 8 ... 12 microns, depending on the properties of the base material, the method of application and the coating material. The coatings can be single or multi-layer. In the case of multilayer coatings, the lower layers are made more ductile - from titanium or molybdenum carbides, the upper ones are harder - from titanium nitrides or ceramics. The experience of using tools with wear-resistant coatings has shown that their durability increases 2 ... 3 times, cutting forces and temperature decrease by 20 ... 25%.

Comparative evaluation of cutting properties of tool materials

The cutting properties of tools made from various tool materials can be assessed by comparative comparison, for example, in terms of heat resistance (Fig. 1).It can be noted (see Fig. 1) that heat resistance is in a certain correspondence with other physical and mechanical properties - hardness and strength. With the growth of the latter, the heat resistance also increases. But there is no direct proportionality here. So, the hardness of carbon and low-alloy steels is not inferior to the hardness of high-speed steels, and their strength properties differ insignificantly. At the same time, the heat resistance of high-speed steels is more than 2.5 times higher than that of carbon and low-alloy steels. An exception is also the low heat resistance of synthetic diamonds, while in terms of hardness they occupy one of the first places among other tool materials.

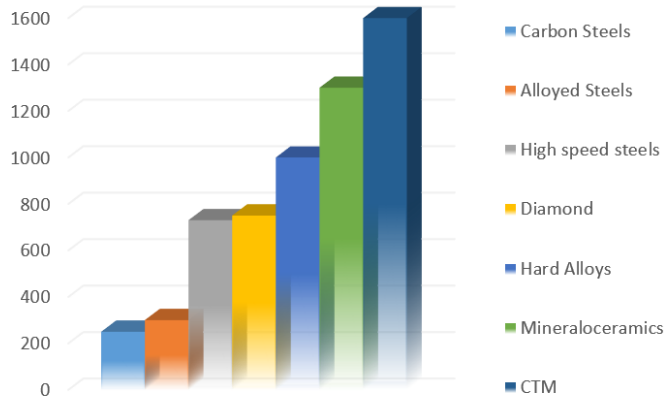

Figure 1 - Comparative characteristics of the heat resistance of materials

References

1. Умаров, Т. У., Турсунбаев, С. А., & Мардонов, У. Т. (2018). Новые технологические возможности повышения эксплуатационной надёжности инструментов для обработки композиционных материалов. In *ТЕХНИКА И ТЕХНОЛОГИИ МАШИНОСТРОЕНИЯ* (pp. 70-74).
2. Gołombek, K., & Dobrzański, L. A. (2007). Hard and wear resistance coatings for cutting tools. *Journal of Achievements in materials and manufacturing engineering*, *24*(2), 107-110.
3. Umarov, T. U., Mardonov, U. T., Khasanov, O. A., Ozodova, S. O., & Yusupov, B. D. (2020). RESEARCH OF THE VARIATION OF FIRMNESS OF POINTED DRILLS BY METHOD OF SIMULATION MODELING OF PROCESS OF WEAR. *International Journal of Psychosocial Rehabilitation*, *24*(04).
4. Тураходжаев, Н. Д., Турсунбаев, С. А., Одилов, Ф. У., Зокиров, Р. С., & Кучкарова, М. Х. (2020). Влияние условий легирования на свойства белых чугунов. In *Техника и технологии машиностроения* (pp. 63-68).
5. Турсунбаев, С. А. (2019). Особенности обработки деталей из магнитотвердых материалов. In *ТЕХНИКА И ТЕХНОЛОГИИ МАШИНОСТРОЕНИЯ* (pp. 23-27).
6. Odilovich, U. E., & Ugli, M. U. T. (2020). Analyzing the effect of magnetic field on Lubricoolant in machining process. *IJAR*, *6*(5), 347-352.
7. Uljayev, E., Ubaydullayev, U. M., Tadjitdinov, G. T., & Narzullayev, S. N. (2021). Development of Criteria for Synthesis of the Optimal Structure of Monitoring and Control Systems. In *11th World Conference "Intelligent System for Industrial Automation"(WCIS-2020)* (pp. 559-563). Springer International Publishing.
8. Ulzhaev, E., Narzullaev, S. N., & Norboev, O. N. (2021, January). Substantiation of application of artificial neural networks for creation of humidity measuring devices. In *Euro-Asia Conferences* (Vol. 1, No. 1, pp. 86-91).