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## **APPLICATION OF THE CUTTING TOOL WITH WEAR RESISTANT COATINGS IN FACE MILLING OPERATIONS ON PLAIN SURFACES**

One of the promising ways to improve the efficiency of the cutting tool is to apply wear-resistant coatings on its working surface. The condensation of matter in vacuum with ionic bombardment (CIB method) is the most widely used method for the application of coatings developed in our country. The CIB method is universal in terms of the application of wear-resistant coatings of various composition and structure, which allows to change the properties of the surface layer of both the carbide and quick-cutting tool in wide range. Application of coatings obtained with the CIB method can significantly increase the endurance of the cutting tool in the processing of workpieces from structural materials. In recent years, the development of CIB technology is directed towards the development of multilayer coatings, which are the most promising and increasingly used in tool manufacture.

Despite the extended application of CIB wear-resistant coatings in the industry, including the use of multi-layered ones, the issue of their design and components selection remains open. The absence of scientifically substantiated principles for the formation of multilayer coatings leads to the fact that the same coatings are often recommended for different processing conditions, and conversely, different types of coatings are used under the same conditions of cutting.

This article considers the possible ways to increase the effectiveness of the cutting tool with the coating on operations of face milling.

In view of the fact that the contact processes occurring on the work surfaces of the cutting tool depend on the cutting conditions, the requirements for wear-resistant coatings must be determined by the type of machining process. Thus, with continuous turning, it is necessary to ensure, first of all, high hardness of the coating, its inertia in relation to the material being processed. At the same time, with discontinuous cutting, the formation of discrete chips and the fluctuation of cutting margin in the following requirements dominate, such as high fatigue strength and impact strength of the coating material. Taking into account that the main reasons for the destruction of a cutting tool while face milling: the formation of crack network in the coating and tool base and the detachment of the coating as a result of the influence of the alternating heat and power loads and the separation of the stagnant zone when there is no contact of the tool with the workpiece, it is possible to highlight the following main areas for improving the effectiveness of the tool:

1) increase of the crack strength and durability of the coating material and the composition "coating - tool base" in general, which can be ensured by improving and optimizing the technological process of its application, change in the composition and design of the coating;

2) reduction of the adhesive interaction of the contact areas of the tool with the treated material by choosing the coating material or the directional change in its

properties, which will reduce the intensity of the processes of the incrustation of the volume of the tool material as a result of the separation of chips from the front surface when there is no contact of the tool with the workpiece;

That is, in order to maximize the efficiency of the cutting tool in face milling, it is necessary to create a coating that at the same time has high strength and crack resistance, low adhesion to the treated material and the ability to minimize the level of thermal and power loads on the tool.

Accordingly, the mechanical properties of the coating are determined by its composition and structural parameters (grain size, phase composition, presence of defects, texture, residual strain), which in their turn are determined by the technological parameters of the deposition process.

Thus, in the works of the following scientists Biakova A.V., Vereshchaka A.S., Moiseev V.F. the influence of the pressure of the reaction gas on the microhardness and the resistance to cracking of TiN coating, the strength of adherence of coatings with the base, the magnitude of residual strain has been investigated. It is shown that by changing of the pressure of the reaction gas it is impossible to simultaneously achieve the greatest microhardness and plasticity of the coating, the strength of its adhesion to the base, the maximum value of residual compressive strain in the coating and minimal adhesion to the treated material. Similar results were obtained by the researcher Tabakov V. P., who investigated the relationship between the condensation temperature and the structure, residual strain, microhardness of the coating, the strength of its adhesion to the base and the tool endurance .

The structure, properties of the coating and the working capacity of the tool depends on the thickness of the coating. The conducted researches have established, that with decrease in the thickness of the coating, its plasticity and the strength of adhesion with the base increase, the number of defects and the size of the grain decrease, and the residual strain level changes. The effect of the thickness of the coating on its properties is reflected in its optimum value for different cutting conditions.

A more promising direction of increasing the strength and crack resistance of the composition "cover - instrumental material" is the creation of composite coatings. Coverage of the complex composition allows to vary the properties of the composition "cover - instrumental material" more broadly and increase the efficiency of the cutting tool for different types of processing and cutting various materials. This is due to the fact that complex compounds have high thermodynamic stability, hardness and durability, a wide area of homogeneity, which allows them to change their properties in wide limits by changing the composition.

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