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Asymptotic properties of the variables of the roughness surface

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ABSTRACT

The authentic technological process is described by the presented relation expressed by the consensus of the experiment. Theoretical information and new aspects on calculation of the roughness values of the cut surface for the chosen materials are being presented. The properties of the cut surface are being described by specific dependency of the cutting force at the cutting speed.

1. Introduction

In the field of mechanical engineering, surface components that are being machined have the required accuracy of dimensions. Parts are manufactured at certain intervals, using different technological operations on multiple machines. The nature of the compilation of products lays in discrete operations although automation of technological processes leads to reduction in the number of discrete operations. The methods of manufacturing engineering enable the analysis of the dependences of the characteristic parameters accompanying the occurrences of surface components. Machining is a technological procedure which removes material from the surface and thus the function and the service live of the product is being achieved. A machining is a basic technological process for many materials and as a result the products with the dimensional accuracy are being manufactured [1]. The methods of machining are constantly being improved and researched. Physical methods of machining are used for materials with high hardness that are hardly machined and the cutting tool would be very hard and its shape would be cylindrical with a diameter of 0.5 mm, groove width to 1 mm to shape a surface. The several factors such as new high-strength materials, the anti-corrosive materials, the antimagnetic and other engineering materials influence the machining. Requirements for the dimensional tolerances and for the machined surface influence the machining [2]. Machining volume decreases with the decreasing of the share of the roughing operations, and increases with the finishing operations share. The advantages of the technological methods are the possibility of automation as well as production cost minimisation.

Machining methods have to be improved because the developments of machining operations affect other engineering technologies such products forming and casting. The new machining methods are successfully used in the process of making products having special properties. The cutting forces, durability of the cutting tools, the maximum height of the machined roughness surface and many others influence the quality of the machined surfaces. Knowledge of the cutting materials variables is essential for the parts machining.

Literature on cutting variables deals mainly with cutting variables of steel, carbide and ceramics high speed cutting. Knowledge of the some cutting variables for sintered carbide as a material for cutting tool is being presented in the next part. These relationships have not been published yet.

The durability of the cutting tool is being investigated as the durability of the head of the tool as well as the cutting tool wear. Some other variables such as maximum height of the roughness

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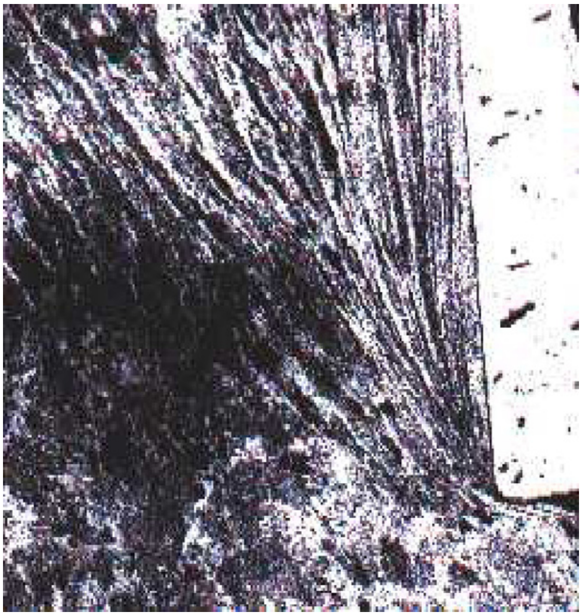

Fig. 1. The cutting surface [1].

surface of the machined surface are being determined using mathematical formula and functional dependences. Selected variables are expressed mathematically. The asymptotic properties of the selected variables are determined for the selected functions. Triviality, monotony, boundedness are considered to be the asymptotic properties in the next part. Asymptotic properties of the physical variables are derived from the operator formula for the cutting surface. Based on the experimental dependence, the formula for the cutting force of the cemented carbide tool dependence on the cutting speed was determined. Several technological challenges can be addressed using conventional machining methods and superhard cutting materials based on industrial diamond or cubic boron nitride [3]. Development of cutting materials leads to higher hardness, resistance to high temperatures and wear resistance and characteristic feature is the emergence of a significant layer which is formed from the blade tip. Minimal movement of the fibrous layer (the speed of movement is at the forefront of virtually zero and rises towards the chip) reminds runny liquid (Fig. 1).

2. Experiments and mathematical relations

Cutting process research points to the existence of the wear variable of the tool cutting head when chips are being formed on the machined surface. The changed temperature that occurs when the cutting tool touches the cutting surface influences the deformation of the tool head [4]. The investigation presents the information in the theory durability of the cutting tool by the dependency of the wear of the cutting tool at the cutting speed of the material cemented carbide. The investigation of the cutting tool wear is expressed by the durability variable of the cutting tool. The durability of the cutting tool is expressed in the dependence of the durability on the cutting speed when investigation of the cutting tool head wear using cemented carbide cutting tool was realised. The durability of the cutting tool is denoted by the variable T. This result documents the extreme impact of the cutting tool head wear on the cutting process. The contact surfaces of the cutting tool and the cutting work-piece are also investigated at the high cutting speeds [5]. The relation (1) is one of the findings of the investigation. The relation describes the dependence of the durability of the cutting tool on the cutting speed. The durability of the cutting tool assumes the extreme values with the cutting speed in the immediate of the value

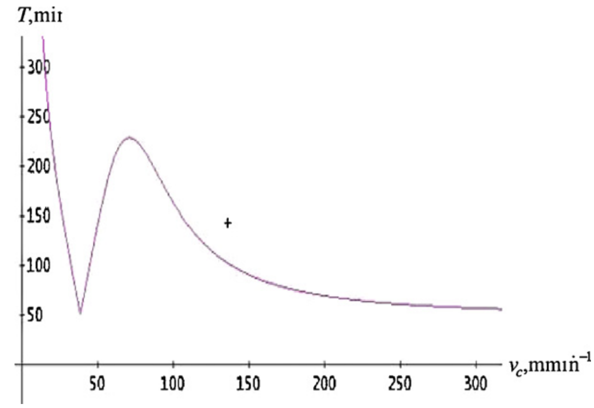

Fig. 2. The dependence of the durability of the cutting tool $T = T(v_c)$ of the cemented carbide according to the relation (1).

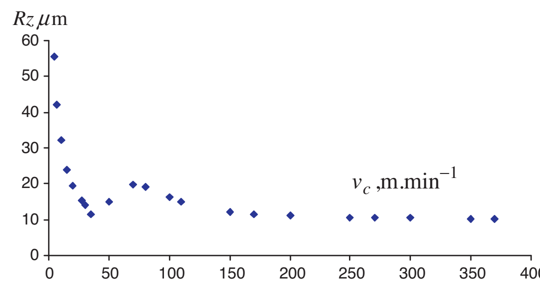

Fig. 3. The dependence of the maximum roughness of the cut surface Rz on the cutting speed v_c.

of the speed equals 20 m min^{-1}. If the values of the durability of the tool are increasing then the quality of the surface is first improved. If the cutting speed is increasing then the durability of the cutting tool is decreasing. The durability of the cutting tool is decreasing if the value of the cutting speed is greater that 80 m min^{-1}.

The relation for the dependence the durability of the cutting tool at the cutting speed is expressed as follows (1) (Fig. 2):

$$T = \frac{18}{29}\left|\frac{((40-v_c)/40)^3-((40-v_c)/40)20.26+19}{1-((40-v_c)/40)^3}\right|+50 \qquad (1)$$

The surface quality is improved because the material is machined in a state of the contact with the surface of the chip where by the internal friction between the layers of the chips with the cutting surface the higher thermal stress is generated and penetrates into the cutting tool [6]. The maximum roughness cutting surface Rz is described by relation (2) in the following form:

$$Rz = \frac{1}{29}\left|\frac{((40-v_c)/40)^3-((40-v_c)/40)20.26+19}{1-((40-v_c)/40)^3}\right|+10 \qquad (2)$$

The graphical dependency of the maximum roughness of the cut surface to the relationship (2) is expressed in the next graph (Fig. 3).

The exact expression of the dependence of the cutting force on the cutting speed is analogous to the previous relationship (2) for the maximum roughness of the cutting surface. The maximum value and the minimum value of the maximum roughness of the cut surface are for the equal values of the cutting speed considered as the extreme values of the cutting tool durability. The relation (2) is applied to express the values of the cutting force in the following form:

$$F = C_1\left|\frac{((C_v-v_c)/40)^3-((C_v-v_c)/40)20.26+19}{1-((C_v-v_c)/40)^3}\right|+C_2 \qquad (3)$$