ANALYSIS OF FINISH TURNING OF Ti-6Al-4V TITANIUM ALLOY UNDER MQL CONDITIONS USING GRAPHITE MICRO-POWDER ADDITIVE

Abstract

The Ph.D. dissertation concerns on the determination of the effect of the addition of graphite micro-powder of different concentration in various biodegradable base liquids on selected machinability indexes of the Ti-6Al-4V titanium alloy and the state of the technological surface layer in the finishing turning in MQL conditions. In the thesis, an analysis of interactions and modelling of relationships between the process setting parameters, i.e. cutting speed, feed rate and mass concentration of micrometric graphite micro-powder in the base liquid, and the components of the cutting force and the surface roughness parameters of the workpiece *Sa* and *Sz*, was carried out.

In the first part of the work, an analysis of the literature was carried out. It presents a brief characteristic of titanium and its alloys and presents solutions used in the cooling and lubrication of the cutting zone during machining. The results of earlier research on the machining of metal alloys in MQL conditions with the use of pure base liquids and liquids with micro- and nanoadditives are presented, with particular emphasis on publications on the machining of titanium alloys in MQL conditions with liquids with the addition of micro- and nanoparticles.

In the following chapter, the aim, hypothesis, and scope of the work are given. Then, the conditions of experimental research were discussed: test stand, workpiece, cutting tools, and liquids used in MQL conditions. The next part of the work is preliminary research. The method of supplying the cooling and lubricating liquid to the cutting zone and the value of the liquid output were determined, and the base liquids were selected.

The main part of the work was research on the influence of mass concentration of graphite micro-powder in the base liquid on tool life and chip shaping. Models were developed showing the relationship between the setting parameters of the process, i.e. cutting speed, feed rate and mass concentration of micrometric graphite micro-powder in the base liquid, and the components of the cutting force and the basic parameters of surface roughness. Statistical and graphical analysis of the results obtained was also presented. The microstructure of the surface layer after machining was also checked.

The work was concluded with a summary and final conclusions. The elements of novelties that appeared in the work were articulated and possible directions for further research were presented.