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THEORETICAL AND EXPERIMENTAL RESEARCH CONCERNING DIMENSIONAL SHAPING OF METAL-CARBIDE BY MEANS OF ULTRASOUNDS

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Abstract: this paper presents the authors' theoretical and experimental preoccupations concerning the dimensional working of the metal-carbide pieces by means of ultrasonic erosion, as well as the influence of the technological parameters and of the abrasive suspensions over the quality and working speed.

INTRODUCTION

One of the factors that produced the fast development of the machines construction industry, electrotechnics, fine mechanics, optics, aeronautical industry etc. consists of the use of acoustic waves on larger and larger extent.

The acoustic waves can be classified as follows:

- infrasound waves, with frequency range 0.5 ÷ 20 Hz;
- sound waves, with frequency range 20 ÷ 20000 Hz;
- *ultrasound waves*, with frequency range 16000 ÷ 10^{10} Hz;
- hypersound waves, with frequency range 10^{10} ÷ 10^{14} Hz.

The ultrasound waves have the largest applicability in the machines construction industry, as direct working method or in assisting of other technological processes.

The distinct features of ultrasonic waves, as well as the effects connected to their propagation (short wavelength, large acceleration of the medium particles, precise directing of a sharp ultrasonic beam, energy concentration in a limited space, the cavitation effect etc) determined the apparition of numerous applications in various technical domains, as well as in medicine, biology, scientific research etc.

Ultrasounds are used in dimensional shaping by means of chipping, plastic deformation, abrasive erosion, washing and burr-removing processes. The dimensional shaping is applied mainly in the technology of metal-carbide draw-plate making and, with remarkable results, in the technology of diamond draw-plate making. The ultrasound erosion is applied to the materials with high fragility, average hardness and which do not plastically deform prior to breaking. Such materials are: glass, quartz, ceramics, silicon, ferrite etc. The universal ultrasound installations feature multiple use ranges, as shown in tab.1.

Tab.1. Use of ultrasound working for various materials.

Destination of the machine	Worked materials	Maximal dimensions of the worked surface [mm]	Ultrasonic generator power [W]
Micro-hole drilling	glass, ferrite, ceramics	5 ÷ 7	100 ÷ 500
Small surfaces generation	ferrite, steel	10 ÷ 20	250 ÷ 300
Cutting	semiconductors		
Drilling	ceramics, metal-carbide	20 ÷ 22	500 ÷ 700
Small holes drilling	metal-carbide, steel	40 ÷ 45	1000 ÷ 1400
Cutting	quartz		
Draw-plate and die working	metal-carbide	80 ÷ 85	2000 ÷ 2500

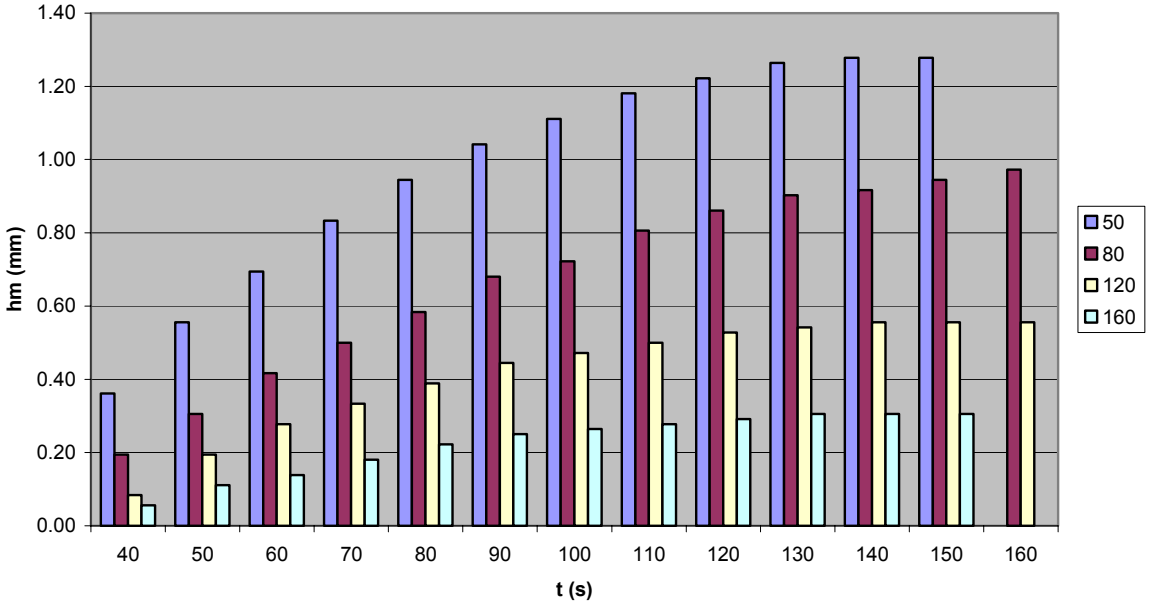

Fig.8. Influence of the working time* t *and of granulation over the penetration depth.

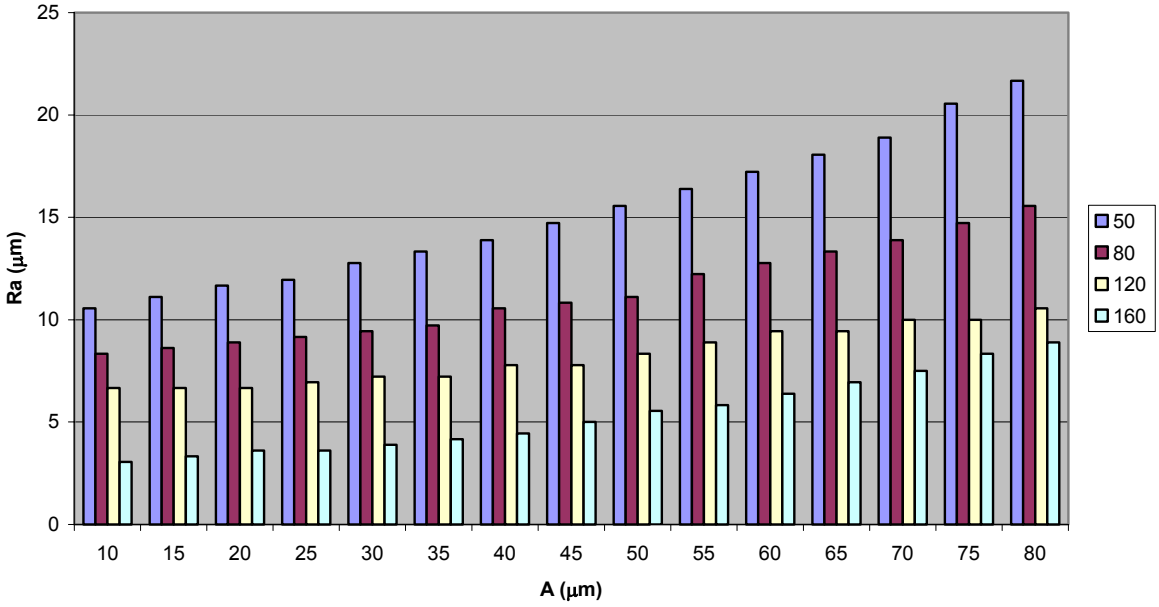

***Fig.9. Influence of amplitude* A *and of granulation over the surface roughness* Ra.**

CONCLUSIONS

The experimental research showed that the size of the abrasive particles and the ultrasonic oscillations amplitude influence directly the worked surface roughness. The advantage of ultrasound working versus other non-conventional methods (electrical

erosion, electro-chemical erosion etc) consists of the fact that both electrically conductive and non-conductive materials can be worked. The tool does not require special materials and can be made of steel. According to the tool dimensions and shapes, simple and profiled drilling can be performed. The static pressure is also important over the working speed – the optimal value is $1 \div 3$ daN/cm^2.

The working accuracy increases as the abrasive grains are finer. Metal-carbide, hard steel, brittle non-metallic materials, glass, ferrite, composite materials and alloys that mostly cannot be worked by means of other method can be worked by means of ultrasounds.

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