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K. Mouralova, R. Matousek, J. Kovar, J. Mach, L. Klakurkova, J. Bednar

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Analyzing the Surface Layer after WEDM Depending on the Parameters of a Machine for the 16MnCr5 Steel

K. Mouralova[1], R. Matousek[1,2], J. Kovar[1], J. Mach[1], L. Klakurkova[2], J. Bednar[1]

[1]Brno University of Technology, Faculty of Mechanical Engineering, Brno, Czech Republic
[2]Brno University of Technology, CEITEC - Central European Institute of Technology, Brno, Czech Republic
mouralova@fme.vutbr.cz

Abstract

The efficient wire electric discharge machining (WEDM) technology is a trade-off between the cutting speed and the resulting surface quality. A typical morphology of a surface machined using WEDM contains a large number of craters caused by the electric sparks generated in the cutting process. The paper analyzes the influence of the cutting speed on the quantitative and qualitative evaluation of the craters formed on the surface of a workpiece made of the 16MnCr5 steel. Applying metallography to cross-section microscopic slides, diffusion subsurface damages were studied caused by the cutting. The diffusion processes taking place between the electrode and the material machined were studied using a local point EDX microanalysis applied both to the machined surfaces and to the cross sections. A detailed study was also carried out of the brass electrode to measure its wear rate caused by the cutting process as well as its degradation in terms of the quality of its morphology and the chemical composition of surface.

Keywords: WEDM, electrical discharge machining, design of experiment, surface investigation, metallography, EDX

1. Introduction

Electric erosion is a physical process of material removal taking place simultaneously on both electrodes immersed in an operating medium. This medium is always a liquid dielectric with high electric resistance. The electric discharge between the electrodes is initiated by the high voltage brought to the electrodes. Taking place between the wire electrode and the workpiece, the electric discharges create a gap and, thus, a cut [1-4].

No classic cutting forces occur while the electric-erosion cutting so that it is possible to machine conductive materials regardless of their hardness, toughness, and mechanical properties [5, 6]. Thus, the workpieces can be machined to their final sizes even after final thermal treatment. In this way, undesirable size and volume changes can be avoided.

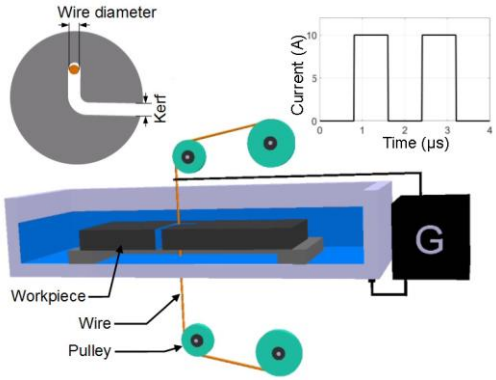

Fig. 1. Wire electrical discharge machining.