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MONITORING AND CONTROL OF THE ELECTROCHEMICAL MACHINING PROCESS UNDER THE CONDITIONS OF A VIBRATING TOOL ELECTRODE

Electrochemical machining process of curvilinear surfaces with a shaped electrode is still considered one of basic operations within this technology. In a case of machining such complex surfaces it is difficult to design constant values of this process for the whole of the machining time and additionally ensure high production efficiency. This paper presents a system for controlling and monitoring the electrochemical machining process in a way which allows a suitable modification of parameters related to the kinematics of a tool electrode, including the frequency of its vibrations and tool design stage verification and optimization of machining equipment behavior. The parameters are modified according to designed criteria. The article also presents the research station which was used for verification of the presented system, as well as the effects of this verification.

Keywords: computer simulation, tool design, electrochemical machining, process monitoring, process control, equipment behavior

1. INTRODUCTION

During electrochemical machining (ECM) the machined item and the tool make up a system of electrodes, in which the machined item is connected with a positive pole of an electric power source. This system creates also an inter-electrode gap in which the electrolyte flows. Material from the machined item is removed through electrochemical processes after applying voltage to the electrodes.

Accuracy in electrochemical machining is conditioned by the shape of the tool electrode and thickness of the gap between the tool electrode and the machined item. In standard continuous current electrochemical machining for gaps smaller than 0,2mm continuing this process is rather difficult. It is caused by many factors, among others:

- due to heating of the electrolyte caused by the flow of electric current,
- gas phase emission in the electrolyte,
- creation of solid products in the electrolyte, mainly metal hydroxides,
- low speed of the electrolyte flow,
- high changeability of conditions in the inter-electrode gap in case of electrode surfaces with complex curvilinear shapes.

Changes in electrical conductivity connected mainly with variable temperature disposition and electrolyte properties in the inter-electrode gap have a significant influence on electrochemical machining accuracy. CAE-ECM system developed by Kozak (1998) allows defining conditions in the inter-electrode gap, including changes in electrical conductivity, which are mainly connected with the changing temperature distribution and properties of the electrolyte. The mechanism of changes in electrical current density distribution were researched by Kunieda and his team with the

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