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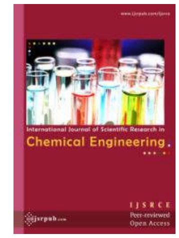

Full Length Research Paper

Experimental Investigation of Electrochemical Machining Process using Taguchi Approach

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Abstract. Electrochemical Machining is one of the major alternatives to conventional methods of machining difficult to cut materials and generating complex contours, without inducing residual stress and tool wear. Electrochemical machining process is a metal machining technology based on electrolysis where the product is processed without both contact with the tool and thermal influence. The metal workpiece is partially machined through electricity and chemistry i.e. electrochemical until it reaches the required end shape. The shape accuracy of the end product depends on the size of the gap. In the present study, the influences of ECM cutting parameters such as supply voltage, tool feed rate, electrolyte concentration and current, keeping other parameters constant, on the material removal rate and surface roughness were presented. In addition Taguchi approach and analysis of variance (ANOVA) are used to optimize ECM process. Among the four process parameters, supply voltage (46%) influences highly the material removal rate, followed by tool feed rate (19%), current (6%) and the electrolyte concentration by (3%).The contribution that have significant for surface roughness are current (53%) influences highly, followed by tool feed rate (21%), supply voltage (11.5%) and the electrolyte concentration by (0.2%). A comparative study of material removal rate and surface roughness mathematically and experimentally basis has been carried out.

Keywords: Electrochemical machining (ECM), material removal rate, surface roughness, Taguchi approach and analysis of variance (ANOVA)

1. INTRODUCTION

Recent developments in different methods of machining have significantly increased the potential for widespread industrial applications of electro chemical machining (ECM) as a non-traditional machining process. Although an increase of material removal arte and a high surface quality has been achieved in earlier investigations, widespread industrial application of electrochemical technology has necessitated a better understanding of the effects of process parameters on material removal rate and surface quality (Swift and Booker, 1997).

Electro chemical machining processe has some unique advantages over other conventional and non-traditional machining processes but its use required relatively higher initial investment cost, operating cost, tooling cost, and maintenance costs (McGeough, 1998). When using ECM process parameters optimally, it can significantly reduce the ECM operating, tooling, and maintenance costs and thus, it will increase the accuracy of components produced which is important in some applications such as aerospace, space, defense, nuclear areas. Therefore, choice of optimum process parameters is necessary to get the most cost-effective, efficient, and economic utilization of ECM process potentials (Benedict, 1987).

Generally the optimization of any process parameters now relies on process analysis to identify the effect of operating variables on achieving the desired machining characteristics (Sameh, 2014 and Krishankant et al. 2012). The optimization of electrochemical machining process was studied by many researchers. Senthilkumar et al. (2012), used Nondominated Sorting Genetic Algorithm-II (NSGA-II) approach to maximize metal removal rate and minimize surface roughness. Rao et al. (2008), presented a particle swarm optimization algorithm to find the optimal combination of process parameters for an electro chemical machining process. Multiple regression model and artificial neural network (ANN) model are developed as efficient approaches to determine the optimal machining parameters in ECM (Asokan et al., 2008). Acharya et al. (1986), proposed multi-objective optimization model for the ECM