World Academy of Science, Engineering and Technology
International Journal of Civil and Environmental Engineering
Vol:9, No:02, 2015

Modeling and Optimizing of Sinker Electric Discharge Machine Process Parameters on AISI 4140 Alloy Steel by Central Composite Rotatable Design Method

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Abstract : Electrical Discharge Machining (EDM) is an unconventional manufacturing process based on removal of material from a part by means of a series of repeated electrical sparks created by electric pulse generators at short intervals between a electrode tool and the part to be machined emmersed in dielectric fluid. In this paper, a study will be performed on the influence of the factors of peak current, pulse on time, interval time and power supply voltage. The output responses measured were material removal rate (MRR) and surface roughness. Finally, the parameters were optimized for maximum MRR with the desired surface roughness. RSM involves establishing mathematical relations between the design variables and the resulting responses and optimizing the process conditions. RSM is not free from problems when it is applied to multi-factor and multi-response situations. Design of experiments (DOE) technique to select the optimum machining conditions for machining AISI 4140 using EDM. The purpose of this paper is to determine the optimal factors of the electro-discharge machining (EDM) process investigate feasibility of design of experiment techniques. The work pieces used were rectangular plates of AISI 4140 grade steel alloy. The study of optimized settings of key machining factors like pulse on time, gap voltage, flushing pressure, input current and duty cycle on the material removal, surface roughness is been carried out using central composite design. The objective is to maximize the Material removal rate (MRR). Central composite design data is used to develop second order polynomial models with interaction terms. The insignificant coefficients' are eliminated with these models by using student t test and F test for the goodness of fit. CCD is first used to establish the determine the optimal factors of the electro-discharge machining (EDM) for maximizing the MRR. The responses are further treated through a objective function to establish the same set of key machining factors to satisfy the optimization problem of the electro-discharge machining (EDM) process. The results demonstrate the better performance of CCD data based RSM for optimizing the electro-discharge machining (EDM) process.

Keywords : electric discharge machining (EDM), modeling, optimization, CCRD
Conference Title : ICECE 2015 : International Conference on Environmental and Civil Engineering
Conference Location : Kuala Lumpur, Malaysia
Conference Dates : February 12-13, 2015