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Abstract

The objective of the present work was to investigate the effects of the various WEDM process parameters on the machining quality like cutting rate, material removal rate, kerf width, dimensional deviation and surface roughness and to obtain the optimal sets of process parameters so that the quality of machined parts can be optimized. The working ranges and levels of the WEDM process parameters are found using one factor at a time approach. The response surface methodology as a design of experiment technique have been utilised to investigate and optimize the various process parameters for different machining characteristics of blanking die material with WEDM. The influence of six process parameters namely pulse on time, pulse off time, spark gap set voltage, peak current, wire tension and wire feed rate have been investigated on machining characteristics namely cutting rate, material removal rate (MRR), surface roughness (SR), kerf width and dimensional deviation. The response surface methodology (RSM) in conjunction with second order central composite rotatable design has been used to develop the empirical models for response characteristics.

In present experimentation, quadratic model is suggested for all three responses. Analysis of Variance (ANOVA) indicate that I_p , T_{on} , T_{off} , SV and WF are significant process parameters influencing the cutting speed, material removal rate and surface roughness. While servo spark gap set voltage and wire feed rate were highly significant parameters influencing the kerf width and dimensional deviation. Desirability function has been used along with RSM for optimization of single and multi objective characteristics. Optimal sets of parameters have been selected corresponding to maximum desirability value. The confirmation tests are performed to validate the mathematical model and to confirm the optimal parametric combinations developed by RSM desirability function, respectively. This PhD thesis will help in punch & die making manufacturing firm to predict the optimum process parameters for getting optimum response.

List of Publications

1. S. S. Patel and J. M. Prajapati, "Multi-criteria decision making approach: Selection of blanking die material," *Int. J. Eng. Trans. B Appl.*, vol. 30, no. 5, pp. 800–806, 2017.
2. S.S.Patel and J. M. Prajapati, "Experimental Investigation of Surface Roughness and Kerf Width During Machining of Blanking Die Material on Wire Electric Discharge Machine," *Int. J. Eng. Trans. A Basics*, vol. 31, no. 10, pp. 1760–1766, 2018.
3. Sandip S. Patel and Dr. J. M. Prajapati, "A Review on State of Arts in Wire Electrical Discharge Machining", *Proceeding of International conference on emerging trends in scientific research (ICETSR-2015)*, C.U. Shah College of Engineering and technology, Wadhvan, Surendranagar, 17-18 December-2015. (ISBN: 978-2-642-24819-9).
4. Sandip S. Patel and Dr. J. M. Prajapati, "A MOORA Based Multi Criteria Decision Making Approach for Die Making Material Selection", *Proceeding of National Conference on Design, Analysis and Optimization in Mechanical Engineering (DAOME-2016)*, M. S. University, Baroda, 18-19 March-2016. (ISBN: 978-93-5258-831-2).