ABSTRACT

Wire Electric Discharge Machining (WEDM) provides an effective solution for machining hard materials with intricate shapes. However, selection of cutting parameters for obtaining higher efficiency or accuracy in WEDM is still not fully solved. This is mainly due to the complicated stochastic process mechanisms in WEDM. As a result, the relationships between the cutting parameters and cutting performance are difficult to establish accurately. Hence, an attempt is made to study the machining characteristic in WEDM, to optimize the process parameters and to estimate the quality of cut surface and accuracy for the given machining parameters.

The present work highlights the kind of surface texture that can be achieved, optimizing important process parameters, study of MRR, Tool life, Productive utilization of the tool, formation of recast layers and kerf width analysis. The possibility of adopting WEDM as a metal cutting operation with a view of increasing the productivity is also studied by experimentation. This is an important study as it controls the MRR, surface integrity and other controlling parameters of the process.

The analysis also deals with studying performance of wire tool electrodes under varied machining conditions, machining different materials at different working conditions like Cutting Voltage, Intensity of the machining pulse and studying the effect of this on the quality of the surface obtained. A detailed analysis of various factors to be considered in selection of wire electrodes, reducing the wear rate, factors leading to failure of wire electrode during machining by analyzing Metal Removal Rate (MRR), Surface Roughness and Metallurgical Evaluation are investigated.

The variation of kerf and MRR with machining parameters and optimization of machine settings for minimum kerf and maximum MRR are investigated experimentally and the obtained results are interpreted and modeled
statistically to understand closely the behavior of machining rate and accuracy in WEDM.

Most commonly used Tool Steel Materials are considered for study like: EN8, EN31, HCHC and P20. Machining was done with different wire materials like: Brass Wire, Coated Brass Wire and Molybdenum Wire. Machining has been done on Fanuc Robocut α-c WEDM Machine. Mahr Gmbh Perthometer M2 is used for Surface Roughness measurements. JSM-840A (JEOL, Japan) Scanning Microscope is used for Micrographs and Link ISIS Oxford Instruments, UK, for EDX analysis.

The most important performance measures in WEDM are MRR, Surface Finish and Kerf (cutting width). Discharge current; pulse duration, pulse frequency, wire speed, wire tension, average working voltage and dielectric flushing conditions are the machining parameters which affect the performance measures.

Among the other performance measures, the kerf, which determines the dimensional accuracy of the finished part, is of prime importance. In WEDM, metal removal rate (MRR) determines the economics of machining and rate of production. In setting the machining parameters, the main goal is the maximum MRR with the minimum kerf. Hence optimization of process parameters for maximum MRR and minimum kerf is done by Design of Experiments and Regression Analysis method. Optimization of process parameters for minimum kerf and maximum MRR has a lot of practical significance in selecting process parameters for the resulting kerf and MRR.

Key Words: WEDM, Machining Impulse, Orthogonal array, Signal-to-Noise ratio, ANOVA, Gap width, Electrode tool wire, Wire wear ratio, Surface Roughness, Kerf, MRR, Micrograph, EDAX