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Effects of EDM Parameters on MRR & SR of automobile Chassis material by ANOVA

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Abstract—Electric Discharge Machining (EDM) is a unconventional machining process somewhere compound and complex shapes can be machined. Only electrically conductive materials can be machined by this method. It is accomplished of machining geometrically complex or hard materials, that are precise and difficult-to-machine such as heat treated tool steels, composites, super alloys, ceramics, carbides, heat resistant steels etc. To observe the all results EN31 heavy vehicle chassis and D3 steel heavy vehicle chassis with respect to weight, stiffness and strength .These materials are being widely used in die and mould making industries, aerospace, aeronautics and nuclear industries. In this work D3steel is the material used for the machining purpose and Copper is used as an electrode. It is essential to consider most number of input parameters to get the better result. In this process Taguchi approach is used to create L27 orthogonal matrix. Experiments were conducted with the L27 orthogonal array based on the Taguchi method. Moreover, the signal-to-noise ratios associated with the observed values in the experiments were determined. The purpose of ANOVA to see the individual effect of control factors on MRR and SR. In the present work, Optimization of MRR and SR on EDM conducted by using Taguchi and ANOVA.

Keywords— Die sinking EDM machine, parameter MRR & SR, Taguchi's method, ANOVA.

1. Introduction and Literature Review

Electrical Discharge Machining (EDM) is a process of material removal using an accurately controlled electrical discharge (spark) through a small gap (approximately 10 to 50 microns) filled with dielectric fluid between an electrode and a workpiece. The hardness of the workpiece has no effect on the process.Electrically conductive material is removed by controlled erosion through a series of electric sparks of short duration and high current density between the electrode and the work piece, both the workpiece and tool is submerged in a dielectric bath, containing kerosene or distilled water. During this process thousands of sparks per second are generated, and each spark produces a tiny crater in the material along the cutting path by melting and vaporization. Generally the material is removed by erosion process. This process is not restricted by the physical and metallurgical properties of the work material as there is no physical contact due to high energy electro thermal erosion between the tool and the work piece. The objective of the present work is to find suitable process parameters to minimize the tool wear as a work piece steel and square copper electrode as a tool and dielectric flushing. The machining parameter selected are discharge current, pulse on time ,pulse off time , voltage , fluid pressure of the tool using Taguchi design approach analysing the responses MRR . The Taguchi's method is used to formulate the experimental layout, ANOVA method is used to analysis the effect of process parameters on the machining characteristics and find the optimal process parameters of Electric Discharge Machining. Optimization helps for finding an alternative with the most cost effective or highest achievable performance under the given constraints, by maximizing desired factors and minimizing undesired ones. In this section, some selected research papers have been discussed related to Electrical Discharge Machining. The studies carried out in these papers are mainly concerned with the EDM parameters such as current, voltage, pulse on time, pulse off time and flushing pressure etc.K. J. Buhariwala and J. S. Hansen (1988) added that with the combination of ultrasonic vibration in the MRR and surface finish improved increased. The research work i.e. lower metal introduced rotary disc for grooving operation on titanium alloy. The rotary electrode was placed above the work material. The difficulty of debris problem was encountered removal rate and arching occurs due to the accumulation of debris particle between the electrode and work piece.K.W. Poh, P.H. Dayawansa (1999) Spark erosion with ultrasonic frequency using a DC power supply instead of the usual pulse power supply. The pulse discharge is produced by the relative motion between the tool and work piece simplifying the equipment and reducing its cost. It is easy to produce a combined technology which benefits from the virtues of compared the various performance measures of rotating electrode with the stationary electrode. The results concluded an improvement in MRR due to the better flushing action and sparking efficiency with little TWR but the surface finish was improved. Karaoglu, N. S. Kuralay (2002) optimized the cutting of Al2O3/6061Al composite using rotary EDM with a disk like electrode with Taguchi methodology. Taguchi methodology revealed that, in general electrical parameters (Peak Current, Pulse duration and gap voltage) affects the machining Performance are MRR, electrode wear rate & surface roughness more significantly than the non-electrical parameters speed of rotational disc. High MRR was found due to superior debris disposal effect of RDE. Jakub Šmiraus1, Michal Richt (2011) compared the effects of high and low frequency forced axial vibration of the electrode, rotation of the electrode and combinations of the methods (vibro-rotary) in respect of MRR, TWR & SQ in EDM die sinking and found that vibro-rotary increases MRR by up to 35% compared with vibration EDM and by up to 100% compared with