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REVIEW PAPER ON EFFECT OF PROCESS PARAMETERS OF ECDM ON RESPONSE VARIABLES

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ABSTRACT

Electrochemical discharge machining is a versatile machining process for micro drilling, micro texturing, and micro grooving of variety of glasses, ceramics and composites. Electrochemical discharge machining (ECDM), also known as spark assisted chemical engraving (SACE), is an effective micro-machining process for non-conducting materials. It has high demand in Micro Electro Mechanical System (MEMS) applications. In this present review Paper, a study of the effective Parameters of ECDM has been carried out with their specific role in Material removal; Surface Finish and Tool wear Rate. The effects of the electrolyte, the pulse on/off-time ratio, the voltage, the feed rate, the rotational speed, and the electrolyte concentration in the drilling and milling processes were studied.

KEYWORDS- ECDM, MEMS, MRR,SACE,TWR etc.

INTRODUCTION

Electrochemical discharge machining (ECDM) is a novel hybrid micro machining process that combines the features of electro chemical machining (ECM) and electro discharge machining (EDM).It involves melting and etching process under the high electrical discharged on the electrode tip during electrolysis that enables the ECDM process to machine very hard and non-conducting materials such as borosilicate glass, quartz, ceramics etc. efficiently and economically.
The performance of ECDM, in terms of MRR as a response parameter is affected by various process parameters. Relationships between these parameters are highly non-linear and complicated. Therefore, it is very difficult to develop a relationship by conventional mathematical modeling. In this study the performance/response characteristic such as MRR will be studied against some important process parameters like DC voltage, gap between tool and work piece, and electrolyte concentration etc.

LITERATURE REVIEW

The various researchers have carried out study on parametric optimization of electrochemical discharge machining process. Cheng-Kuang Yang et al. [1]Experiment were carried out on the quartz for micro hole drilling by varying the tool material and keeping other process parameters like tool electrode diameter, machining depth, electrolyte and its concentration and rotational speed of tool constant. So this study shows that selection of proper tool material is very important in case of micro machining. S. Jawalkar et al. [2] presented review on different materials and machining conditions in ECDM along with some most influencing parameters of the process. The obtained results showed that applied voltage was the most influencing parameter in both MRR and TWR studies.Xuan Doan Cao et al. [3] studied the effect of voltage, electrolyte, electrolyte conc. pulse on/off time ratio, feed rate and rotational speed in drilling and milling processes in ECDM .Chih-Ping Cheng et al. [4] demonstrated the relationship between gas film quality and machining characteristics under different process parameters including applied voltage, tool rotating speed, electrolyte conc. machining depth and tool geometry while drilling micro holes in Pyrex glass by analyzing current signals and dimensions of machined micro hole obtained. Current serves as key determinant for varying the process parameters to achieve better efficiency and accuracy's. L. Harugade et al. [5] three process parameters were selected at three different levels such as applied voltage, electrolyte conc. and inter electrode gap.

The obtained results evidence that applied voltage was found to be most influencing parameter for MRR and KOH shows the better removal rate than other proposed electrolyte solutions used in an experiment.V. K. Jain et al. [6]they have concluded that with the use of reverse polarity quartz cuts at faster rate as compared to direct polarity but it produces adverse effect such as higher overcut, higher tool wear and higher surface roughness.Mohammad Reza Razfar et al. [7]Different types of longitudinal oscillation to the cathode electrode were applied while drilling of glass and the effects of vibration parameters including amplitude, frequency and waveform on machining speed and machining depth were examined. Cheng-kaung yang et al. [8]The comparison between machining by conventional cylindrical tool electrode and the proposed spherical tool electrode was made to focus on the impact of tool electrode shape on initial machining status, discharge frequencyand machining performance. Baoyangjiang et al. [9]presented works on process modeling of ECDM with respect to spark generation and material removal rate. From the experiment it is seen that there is problem of tool wear associated with use of tapered tool electrode.Sumit K. Jui et al. [10] the results obtained from test were rotation of the tool electrode improves the circularity of machined hole along with high aspect ratio and lower surface roughness.

ECDM PROCESS

The work piece to be machined is dipped in an appropriate electrolyte solution. Two electrodes are dipped into the electrolyte. The auxiliary electrode (anode) having much larger surface is kept away from the tool electrode (cathode).when the D.C voltage is applied between two electrodes electrolysis happens, hydrogen gas bubbles are formed at the tool electrode (cathode) and oxygen bubbles at the auxiliary electrode (anode).when the voltage is increased, current density also increases and more and more bubbles grow which form a bubble layer around the electrodes. If voltage is increased above the critical voltage they coalescence into a gas film around the tool electrode. Sparking phenomena is observed in the film where critical discharge happens between the tool electrode and the surrounding electrolyte.

Machining with ECDM is a complex process affected by several process parameters such as applied voltage, electrolyte, electrolyte conc. peak current, pulse on/off time ratio, geometry of

The tool, speed and feed rate of the tool, inter electrode gap, tool-work piece gap etc. and the performance measures are material removal rate (MRR), tool wear rate (TWR) and surface roughness. The machining performance of ECDM is very sensitive to many process parameters. However it is unclear that which parameters influence the machining performance and how these parameters can be optimized. The optimum selection of process parameters plays an important role to improve the quality of product, to reduce the cost continuously in order to compete on price and performance and to increase profitability. Hence to choose optimal parameters it is very essential to understand the interaction between machining parameters and performance measures of ECDM process.

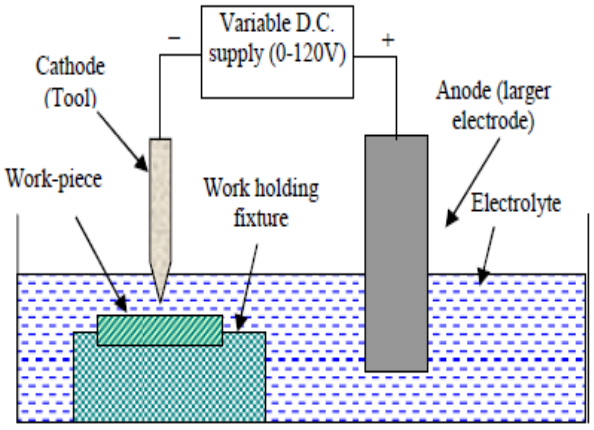

Fig.1Principle of ECDM process

PROPOSED WORK:

The intension of this work is to do micro machining of Soda lime glass by changing the gap between tool electrode and work piece, auxiliary electrode along with change in voltage. Finally parametric study is to be carried out by using suitable software for ECDM process to understand the relation between input process parameters and output process parameters.

OPTIMIZATION OF PROCESS PARAMETERS:

Parametric study is to be performed to investigate the influence of important input process parameters to understand their effect on the output process parameters such as MRR and surface roughness using any suitable statistical tool. Based on the study finally conclusions are presented with suggestion for future work.

CONCLUSIONS

This paper is review on the effective parameters in Electro-chemical Discharge Machining. Based on the study, the following conclusions are drawn:

1. It was found in the researches that applied voltage is the most influential parameter for MRR.
2. Electrolyte concentration is a secondary fact of concern affecting the MRR.
3. The ECDM has capability to provide better results but selection and optimization of parameters is necessary.

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