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# Electro Chemical Discharge Machining Process –A Review

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**ABSTRACT:** Electrochemical Discharge Machining (ECDM) is an rising nontraditional machining method, which mixes the deserves of each spark machining and chemical science machining. it's employed in micromachining non-conductive materials, like glass, ceramics, and composites. Over the previous few years, the will for nonconductive materials has adult speedily in medical, optical, electrical, and region applications. As these applications need machining with high accuracy and high reliability, ECDM has high scope during this field. There are other ways which will machine nonconductive materials, however have bound limitations conjointly. Recently, ECDM could be a developing method and researchers are endlessly attempting to develop and modify it as an improved answer to machine nonconducting materials. within the current paper, a study on continuous enhancements in ECDM in machining of glass, ceramics, composites, and hybridization of ECDM are dispensed with their impact on Material Removal Rate (MRR), Surface finishing, and tool Wear Rate (TWR). it absolutely was more proved that semiconductors and composites were less researched comparatively.

## INTRODUCTION

In recent years, the growth within the field of the many industries like nuclear, automotive, region etc. need nonconventional machining method which supplies high productivity and accuracy. So researchers developed hybrid micro machining method. Electro chemical discharge machining (ECDM) is one such novel hybrid machining method used for machining each conducting and nonconducting engineering materials combining the options of Electrochemical (ECM) and Electro discharging machine (EDM) processes.

**I a . LITERATURE :** The productivity comes from, the ECDM is incredibly abundant then that of ECM and EDM method. In the ECDM method the removal of material is completed by thermal melting. The discharge takes place of tool through electrolyte, the spark can seem once the electrically non conducting work piece of just kept, below the tool within the solution. In 1996 Basak and Ghosh propose the theoretical clarification of the Mechanism of spark generation throughout ECDM method. They reported, the switch of process is an electric circuit. In 1999 a standard mechatronics machining setup which may machine ceramic materials was Designed and developed by Bhattacharya. Later 2014 Paul and Hiremat carried response surface modelling (RSM) of ECDM and chemical etching method where, Gotham and Jain conducted the experiment on borosilicate glass and quartz work piece material with using various kinematic tools like motility, stationary, eccentricity, rotating tools. Its be mentioned that the ECDM velocity mechanism over gravity feed mechanism. The taper side wall flat front too tip form was discovered because it was found to be simplest to regulate machining so circular holes is created absolutely. we can use varied sorts of tools with completely different shapes in ECDM method. As per the form that we've to be created on work material. The various form of tools the sq. cross section with centrally micro hole are used for nonconductive optical fiber reinforced composites. Wuthrich in 2005 shows that adding of surfactants within the electrolytic solution can't be only moisturize the conductor surface, however can also decrease the surface tension, and conjointly will increase the contact extent between the gas bubbles and also the electrode. This makes the advance within the gas film wrapping, effectively lowers the critical voltage, and permits the flows of the electrolytes to decrease the concentration of the variations between the areas and conjointly it will increase the reaction rates. even if the machining scale reaches the order of tens of micrometer, the fundamental properties of such small conductor aren't understood well.

## II. ECDM PROCESS

Electro chemical discharge machining (ECDM) it is known as hybrid machining process mainly used for machining conducting and non-conducting engineering materials while combining both the features of EDM and ECM processes. It is used in micro-machining and scribing hard and brittle, non-conductive materials. Basically for very small material removal, and therefore not for bulk material removing application. So, this is a combination of two processes as the name suggest, in which one action will be by electro chemical reaction, such as chemical reaction takes place, and that causes the dissolution of material into an electrolyte called a working fluid. Therefore, the material removal from the parent body takes place. In addition to that combining another phenomenon that is electrical discharge phenomena, in that material removal takes place in the form of erosion due to the cavitation. Then melting and evaporation of fabric due to the temperatures that develops because the sparks take place. Therefore, these two things are combined along, during this specific conjugation wherever primarily the fabric removal are done by the essential spark erosion method, which is also known for rough machining or the material removal or stock removal method. The smoothening effect will be given by electro chemical effect, which is known for producing smooth surfaces. In this method an electric spark is employed because the cutter to cut(erode) the work piece to provide the finished part to the specified form. Material is removed from the work piece by a series of speedily revenant current discharges between the 2 electrodes, separated by a material liquid and subjected to an electrical voltage. the method depends upon the tool and work piece without any physical contact. once the voltage between the electrodes is accumulated then, the intensity of the electrical field between the electrodes becomes bigger, inflicting material break down of the liquid, and produces an electrical arc. As a result, material is removed from the electrodes. once the current stops, new liquid dielectric is transferred into their electrode volume, enabling the solid particles (debris) to be carried away and therefore the insulating properties of the dielectric into the inner electrode volume is usually stated as flushing. once a current flow, the voltage between the electrodes is fixed as it was dielectric breakdown, therefore new liquid breakdown will occur to repeat the cycle.

### II.a EXPERIMENTAL STUDY OF MATERIAL REMOVAL IN ECDM PROCESS

The schematic diagram of setup is shown in figure.

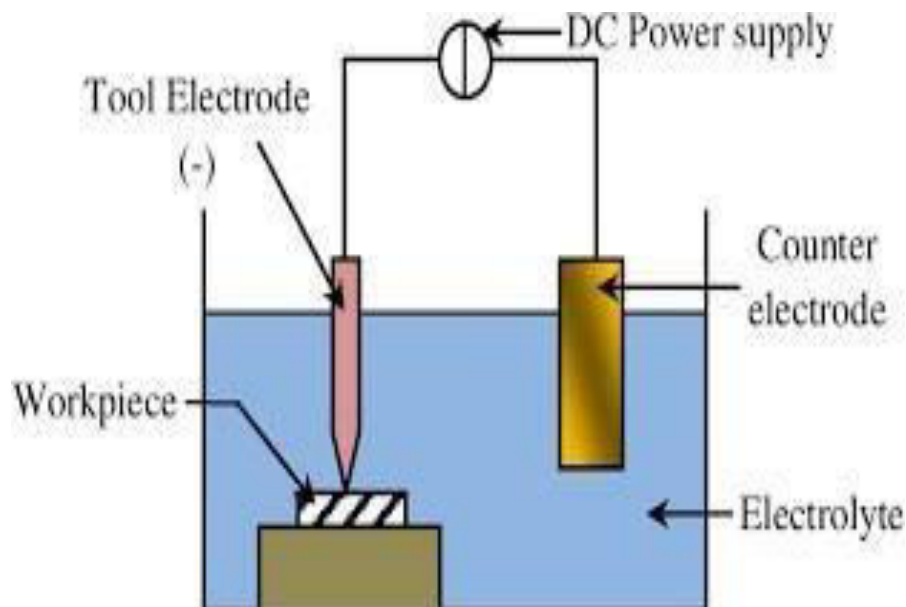


Fig 1 ECDM Setup

It is consisting of electrode, axillary anode of zinc plate, tool feeding mechanism, electrode container, work piece holder, power supply unit and to axis table. In ECDM process, two electrodes is dipped in solution which is alkali electrolyte such as aqueous NaOH and connected to power supply. Here the tool dipped into electrolytes and an axillary electrode comparatively bigger than tool is used as anode. When the voltage is applied, electrolysis starts in the electrolyte. By





electrochemical reaction bubbles at cathode would be generator.

**II b.MACHINING PROCESS:** As soon as an appropriate potential reached between the inter electrode gaps, the different cathode and anode reactions takes place.

1. Plating of metal ions

$M^{+} + e^{-} \rightarrow M$  where,  $M \rightarrow$  Anode

2. Evolution of hydrogen gas

3.  $2H_2O + 2e^{-} \rightarrow 2(OH)^{-} + H_2$

Reaction at anode (auxiliary mode)

4. Dissolution of metal ions in the electrolytic solution  $M \rightarrow M^{+} + e^{-}$

5. Evolution of oxygen gas at the auxiliary electrode  $4(OH)^{-} \rightarrow 2H_2O + O_2 + 4e^{-}$

Experiments, conducted is in keeping with the help of experiment and result be measured for every experiment. The amount of fabric removed is by taking differencing the load of the work before and once machining weight1 (W1) and weight2 (W2) severally. Since ECDM could be an advanced hybrid method, absolutely the mechanism of removal of henceforward, several approaches has been conducted for analyzing and up ECDM method. In several works thus far, at totally different levels varied method parameters has been examined. As associate degree example rule et al

(10) has experimental spherical tool and showed as that the accuracy and potency are often improved with even this kind of tool form. Another one such example, Razfar applied longitudinal vibration to tool and enlarged material square measures are still below researching the Metal removal rate (MRR) in ECDM method. Likewise, Han et al. enforced a surface broken tool, that may improve the machining stability.

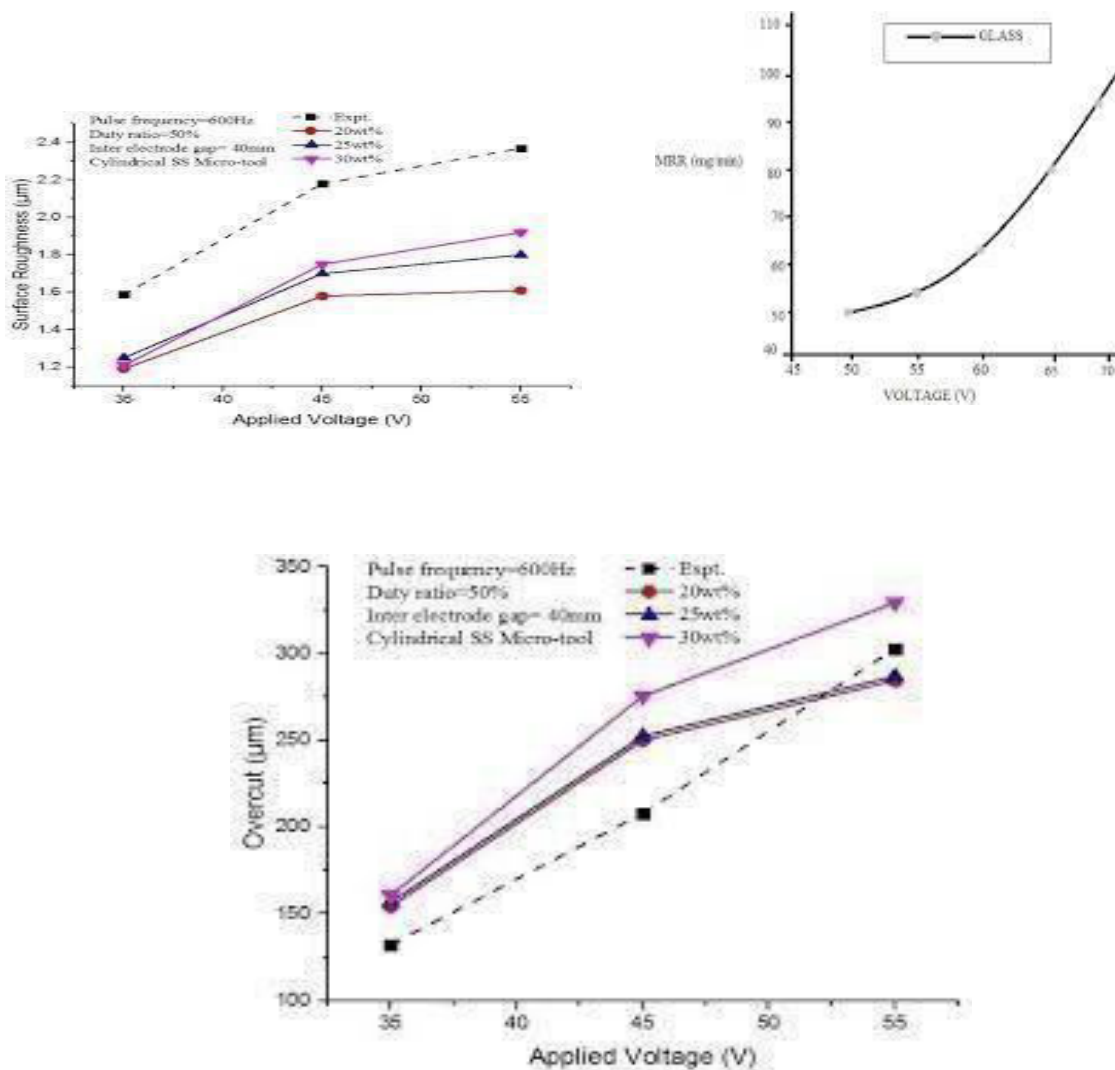
## II. MATERIAL AND METHODS

The experimental association is illustrated the chemistry molecular compressed a device electrode and a counter electrode submerged in 10ml NaOH solution contained within a nicely of Primaria plate. five The devia electrode become a stainless-steel machining needle with a tio diameter of regarding 110µm and the counter electrode become a 1mm diameter. the stainless steel twine coiled on the stop to ring the devia conductor. Experiments ordinarily used a 40V cOnsistent DC capability that became enforced the usage of a energy deliver and produced common up to date of round 700MA with huge contemporary fluctuations throughout discharges for experiments the usages of a tungsten device electrode a 64V

ADC energy deliver became used with within the experiments 180µm skinny or 500µm thick borosilicate glass substrates had been used. both electrode had been attached on a drill head for managed vertical movement and gravity feed touch of the device electrode tip into the substrate with force of  $127 \pm 19 \text{ Nmm}^2$ . an x-y degree from throlabs became used to put the device electrode and enabled peak throughout experimentation for the green optimisation of ECDM conditions. ECDM experimental worried the usage of electrode concentrations . 5% , 10% , 20% and both (w/v) NaOH. each electrode had been attached on a drill head for managed vertical movement and gravity feed touch of the device conductor tip into the substrate with force of  $127 \pm 19 \text{ Nmm}^2$ . The deva electrode turned into a chrome steel machining needle with a tio diameter of about 110µm and the counter electrode turned into a 1mm diameter. The stainless steel twine coiled on the stop to ring the deva electrode an x-y degree from Thorlabs became used to place the device conductor and enabled peak throughout experimentation for the green optimisation of ECDM conditions. within the course of ECDM the tiny extent solution is heated through joule heating and ignition of the guillotine film, and also the majority electrolyte temperature changed into monitored the used of a kind thermocouple . thermometer ECDM optimisation experimenter ordinarily worried a used to machining there holes a therefore referred to as tapping mode approach changed into went to refresh the solution in the within the machining web page for the duration of extended and deep etching. Experiments ordinarily used a 40V cOnsistent DC capability that became enforced the usage of a energy deliver and produced both electrode had been attached on a drill head for managed vertical movement and gravity feed touch of the device electrode tip into the substrate with force of  $127 \pm 19 \text{ Nmm}^2$ .

### III. RESULTS AND CONCLUSIONS

The average values of the three set of experimental results thus obtained, were used and plotted in graph to analysis the influence of various process parameters on various machining characteristics. A series of experiments were undertaken to optimize and characterize ECDM methods using the simple apparatus developed in house. These methods are presented in this section and further developed to comparative evaluation of the anodic ECDM method.



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