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EXPERIMENTAL INVESTIGATIONS ON ECDM: A REVIEW

YUGESH KHARCHE[1], DR. NEERAJ KUMAR[2]

1. Ph. D Scholar, Department of Mechanical Engineering, Suresh Gyan Vihar University, Jaipur (Raj.)
2. Professor & Head of Department, Mechanical Engineering Department Suresh Gyan Vihar University Jaipur Rajasthan.

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Abstract: The ECDM is a non-traditional machining technology acclimated for machining of electrically non-conducting abstracts like glass, ceramics, quartz etc. In this paper, the assorted analysis on ECDM by assorted authors are discussed. The abstraction of electrochemical acquittal machining (ECDM), as well accepted as electrochemical atom machining (ECSM), was presented for the aboriginal time in 1968. This analysis commodity presents an absolute analysis of these contempt developments in ECDM process, its variants abnormally the agency MRR which is the prime and alone affair in amalgam machining industry. The approaching analysis possibilities are articular and presented as analysis potentials.

Keywords: ECDM, MRR, ADVANCEMENTS

Corresponding Author: YUGESH KHARCHE

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INTRODUCTION

Electrochemical discharge machining is a discharge centered fabric elimination approach which has the knowledge for use as a micro-machining system. This process is above all priceless for machining electrically non-conducting materials. This complicated approach includes multiple parameters including instrument-electrode fabric, electrode measurement and form, wettability characteristic of software-electrode, feed-expense, workpiece fabric, utilized voltage, current, electrolyte, gap between software-electrode and workpiece, distance between cathode and anode, anode fabric, and so on.

LITERATURE REVIEW

Jawalkar [1] had compared actual abatement based on the beginning trials application NaCl and NaOH electrolytes and begin that actual abatement application NaCl was abundant apathetic as compared to NaOH. They had aswell appear that at college voltage (70 V) and college electrolyte absorption (22 %) with stainless animate tool-electrode, actual abatement application NaCl band-aid is college than that acquired with NaOH. Abstraction on MRR of Pyrex bottle [2] showed that best MRR accomplished is of 0.7 mm3/min with KOH electrolyte added with SiC annoying and assumption tool.

Similar studies on MRR of Pyrex bottle accept been appear by several authors [3, 4]. Accordingly, the soda adhesive bottle followed by borosilicate bottle charcoal the a lot of accepted abstracts called for beginning purposes in ECDM process. They accept appropriate some approaching ambit in this breadth including apparatus wear, hybridization, use of alluring acreage etc.

Liu [5] analyzed acquittal apparatus while machining able metal cast composite. They developed a archetypal to adumbrate the best acreage backbone position on the balloon apparent and the analytical voltage appropriate for atom initiation.

Jawalkar [6] accept appear the aftereffect of altered ambit and their contributions while machining micro channels on Scott Optical (SO) 3111e bottle with stainless animate tool. Owing to lower specific calefaction capacity, the temperature of the tool-electrode increases bound which after-effects in college acquittal activity. Some letters are aswell accessible with molybdenum as tool-electrode actual [7].

Yang [8] proposed a all-around tip tool-electrode to affected the problems of access in machining time and access bore with access in machining depth. Gupta [9] presented a analysis on the aftereffect of tool-electrode activity ambit like apparatus geometry, apparatus motion, wettability, feed, temperature and absorption of electrolyte on advance in accurateness and ability in the ECDM process. They aswell begin that annular zones are created at the discharge-affected region. Bottle and blended abstracts are two examples.

Schopf [10] accept auspiciously agitated out trueing and bathrobe operation on metal affirmed bowl cutting accoutrement application ECDM process. ECDM activity has been a lot of frequently acclimated for machining non-conducting abstracts although machining of MMCs accept aswell been attempted. Machining of added abstracts such as quartz, Pyrex glass, stainless steel, optical glass, silica accept been reported.

Mediliyegedara [11] presented a new development in activity ascendancy by a PCN based absolute time ambassador for ECDM process; a new activity ascendancy algorithm was implemented.

Kulkarni [12] accept proposed a apparatus to abstraction the temperature acceleration and apparatus of actual abatement during the ECDM activity by barometer the time-varying current. The annoying particles of the annoying coated tool-electrodes enhance the actual abatement by acceptable in throwing out aqueous actual from the machining area in accession to removing ashen actual by abrading process.

Yang [13] acclimated stainless steel, tungsten carbide, and tungsten tool-electrodes bogus by wire electrical acquittal cutting (WEDG) to abstraction the wettability characteristics of apparatus materials. Alive with silica was as well appear by a few authors [14, 15]; best abyss while authoritative canal in silica accomplished was about 780 µm [15].

Machining of metal cast composites accept been appear with a best MRR of 49 mm3/min in a alive action of Water-based chrism added with 0.25-1 wt % NaNO3 at 100 V [7].

Maximum MRR of 5.6 mg/min [16] was accomplished with a alive action of electrolyte NaOH 20% at 65 V and circling of apparatus 20 rpm while machining quartz.

Jain [17] predicted the actual abatement amount in the ECDM conduct by clay the botheration as a 3D capricious accompaniment calefaction advice problem. They apparent the mentioned botheration with the bound aspect adjustment to compute the temperature administration and the actual which attains according to or aloft the melting/softening temperature of the soda adhesive bottle workpiece (Tm/s=850°C) that is afflicted to be removed. They afflicted the analytic temperature for machining was about 820°C. They begin the atom of the thermal ability transferred to the workpiece to be 29 %.

Panda [18] proposed a 3-D bound aspect brief archetypal to appraisal the temperature filed and actual abatement amount (MRR) in traveling wire electrochemical atom machining (TW-ECSM). They declared that the calefaction alteration administration aural the atom has the Gaussian administration and the atom bore was 300µm, according to Kulkarni [19].

Jalali [20] developed a thermal analytic archetypal to bigger accept the actual abatement apparatus in force augment micro-hole ECDM drilling. Their abstraction was focused on the hydrodynamic administration of ECDM drilling. The admiration of the machining temperature was about 600°C as a aftereffect of the allegory amid archetypal and experiment.

Bhondwe [21] developed a thermal archetypal for the anticipation of MRR during ECSM. They accept begin that the alien ambit parameter- inductance could accord connected ability accumulation to ECDM process.

Mechanism of atom bearing during ECDM activity was abundant by Basak and Ghosh [22-23]. Gautam and Jain [24] conducted abstracts appliance assorted apparatus kinematics with an appearance to enhance the activity capabilities. They accept appear that MRR, TWR increases with abridgement in RTW with access in voltage and appliance of the electrolyte. Micro-ECDM was advised by Cao [25] in adjustment to advance the machining of 3D micro-structures of bottle. It was empiric that the attendance of apparatus beating and ancillary blaze afflicted the contour produced on workpiece.

West and Jadhav [26] machined micro-holes with repeatability on borosilicate bottle with electrolyte absorption and temperature of electrolyte as activity parameters. Wuthrich and Fascio [27] conducted abstracts with electrodes of grossly altered sizes in which anode has abundant above admeasurement than that of the cathode.

Lijo and Somashekhar [28-29] had conducted Acknowledgment Apparent Clay (RSM) of ECDM with pulsating DC to accept the aftereffect of assorted activity ambit on micro aperture and micro approach machining for MRR, TWR, HAZ and Radius of Overcut (ROC).

Wuthrich and Hof [30] as well accomplished repeatability in machining with SACE through abbreviation the gas blur array in ECDM activity by accretion the wettability of the electrolyte. The electrochemical acquittal abnormality from the accepted arresting was advised to analyse the gas blur formations and the discharges in SACE [31]. They accept appear photographs of the apparatus electrode beneath altered regimes.

Jain and Adhikary [32] agitated out Electro Actinic Atom Machining with About-face Polarity (ECSMWRP) as able-bodied as ECSM with Direct Polarity (ECSMWDP).

Tang and Zhao [33] begin that accelerated beating, annoying particles in electrolyte and side-insulated electrode advance MRR of Pyrex glass.

Wei [34-35] approved to archetypal ECDM activity in acquittal administration (less than 300 µm depth) with an individual atom appliance FEM. They afflicted the atom of ability transferred to workpiece as 29% in acquittal regime.

Sarkar [37-38] accept begin that the voltage has college access on MRR with lower ROC and Calefaction Afflicted Area (HAZ). Yang [39-40] accept appear that tungsten carbide produced aboriginal aperture bore with atomic apparatus wear. MRR decreases at college abyss due to lower atom which was due to dearth of electrolyte.

Crichton and McGeough [41] conducted abstracts on ECAM with pulsed voltage circuit. Jiang [42] proposed a FEM to associate the atom activity and the geometry of material removed in ECDM process. They accept begin that the administering crumb stabilizes the acquittal accepted in ECDM activity as acquittal activity burning takes abode through the administering crumb alloyed in the electrolyte.

Kulkarni [43-44] attempted to analyze the basal apparatus of ECDM through beginning observations by time-varying accepted in the circuit.

Furutani and Maeda [36] accept conducted abstracts with apparatus circling and appear that depth, amplitude and apparent acerbity of the canal added with access in activated voltage. After they introduced a simple ECDM archetypal to adumbrate the characteristics of the MRR with account to voltage and inductance.

Kulkarni (51) as well begin that abreast of cathode tip occurred due to blur of hydrogen gas bubbles in the electrolyte and a top activating attrition get formed consistent in abeyance of the accepted through the circuit.

Bhattacharyya (46) advised and developed a modular Mechatronics machining bureaucracy which can apparatus bowl materials. They had appear the acquittal abnormality as a switching-off action in an electric circuit. A abstract archetypal was proposed by Basak and Ghosh (45) through which they explained the apparatus of atom bearing during ECDM. They begin that that temperature of the electrolyte aftereffect micro machining.

Fascio (49) aswell begin that if the connected DC voltage activated was beneath a analytical value, electrolysis occurred with accumulation of hydrogen bubbles at the cathode and oxygen bubbles at the anode. Machining of abstracts occurred due to melting, vaporisation of workpiece abstracts by atom and partially due to actinic etching. They begin affinity in the craters formed in ECDM and EDM process, with re-cast furnishings due to the ancillary sparks. At the analytical voltage, accepted body got added rapidly.

Paul and Hiremath (54) had agitated out acknowledgment apparent clay (RSM) of ECDM with pulsating DC to abstraction the aftereffect of assorted action ambit on micro aperture and micro approach machining for Actual Abatement Amount (MRR), Apparatus Wear Amount (TWR), Heat Affected Zone (HAZ) and Diametric Overcut (DOC). The photographs of the apparatus electrode beneath altered regimes with bottle accept been taken by Fascio (48) application current/voltage measurements.

Cao (47) were able to aftermath micro-holes of bore 60 message in bottle with ECDM. In ECDM the actual is removed by thermal melting and actinic carving processes in which the acquittal takes abode from apparatus through the electrolyte. It was followed by balloon bearing as able-bodied as baptize vaporization. They had acclimated amount corpuscle of millimetre ambit to advance gap amid apparatus and workpiece. The bendable accretion address of Artificial Neuro Fuzzy Inference System (ANFIS) was acclimated for modelling and begin that voltage had absolute aftereffect on MRR than electrolyte absorption and apparatus augment rate.

Kulkarni (50) conducted abstracts in ECDM with time-varying accepted and proposed that the temperature acceleration contributes to actual abatement in ECDM. The appropriate of ECDM action is absolutely altered from that of EDM and ECM action if performed independently. W. The abundance of ECDM is abundant college than that of ECM or EDM action (53).

Liu (52) had machined atom able aluminium admixture with wire electrochemical acquittal machining and begin top MRR at top acuteness current, accurate by college electrolyte absorption and assignment factor. Due to top body and the top beggarly ambit the bubbles coalesced into a gas blur about the cathode electrode.

CONCLUSION

This paper studies the various parameters important for MRR in the ECDM. The main aim will be to reduce the DOC and improve the performance of MRR. This paper also depicts the review of various papers presented by different author in this field.

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