Optimization Of Machining Parameters Of Powder Mixed EDM Process.

Karthikeyan.M[1], Karthik Raja.P[2], Kisan.A[3], Naveen Raj.V[4], Vijayakumar.K[5]

1,2,3,4, UG Students, Department Of Mechanical Engineering, K.Ramakrishnan College Of Engineering, Trichy-621 112.

5, Assistant Professor, Department Of Mechanical Engineering, K.Ramakrishnan College Of Engineering, Trichy-621 112.

ABSTRACT

Scientifically emerging industries like automotive, defense, aerospace, electronics, nuclear power, metallic moulds and dies requires materials of high strength, high temperature resistant alloys like carbides, super alloys, haste-alloys etc. Manufacturers strive hard to produce these components at lower cost and of esteem quality as they have a direct impact over the profit earned by the firm. Hence, the productivity can be improved by increasing the material removal rate (or) by reducing the machining time of the product. Addition of a fine conductive powder to the dielectric fluid decreases its insulating strength and consequently increases the inter-electrode space causing an easy removal of the debris. The process variables of PMEDM play a considerable role in material removal mechanism. Performance of the PMEDM process depends upon characteristics like powder type, concentration, particle size, and electrode area and work piece constituents. As a result, the process becomes more stable, thereby, improving the material removal rate (MRR) and surface finish. Moreover, the surface develops high resistance to corrosion and abrasion. In this study, we have chosen the OHNS (Oil Hardened Non Shrinking) die steel as work piece material. A copper electrode and brass electrode with a diameter of 10 mm was used to cut the work piece in EDM. Commercial kerosene has been chosen as dielectric fluid. The consequence of the Machining parameters such as Pulse ON time, Pulse OFF time and current over the Machining time and Surface Roughness has been analyzed. The interaction study is made by Response Surface methodology.

Keywords: *Electrical Discharge Machining, Aluminum Power, OHNS Steel, Parameters Optimization.*

---

1. INTRODUCTION

In 1770 English scientist Joseph Priestly firstly invented the erosive effect of electrical discharge Machining. After that in 1930s, the machining of metals and diamond with electrical discharges has been done. Due to evaluation of spark, erosion was caused by intermittent arc discharges occurring in air between the electrode and work piece which is connected to a DC power supply. Overheating of the machining area restricts the applications of this process, so it is known as "arc Machining". In 1943 at the Moscow University revolutionary work on electrical discharge machining was carried out by two Russian scientists, B.R. and N.I. Lazarenko. Refined and a Controlled process for machining of materials was developed by analyzing the destructive Effects. It becomes easy to maintain and control gap between the electrode and work piece with the introduction of RC (resistance–capacitance) relaxation circuit in 1950s, which provided the First consistent dependable control of pulse times and also a simple servo control circuit. Later Stage RC circuit used as the model for successive developments in EDM technology. In America at same time three employees came up with same results by using electrical discharges to remove broken taps and drills from hydraulic valves. With the reference of this work vacuum tube EDM Machine and an electronic circuit servo system that automatically provided the proper electrode to- work piece spacing (spark gap) for sparking, without contact between the electrode and the work piece. In 1980s with the initiation of Computer Numerical Control (CNC) in EDM Brings remarkable advancement by improving the efficiency of the machining operation. EDM Machines have become so stable with the regular improvement in the process, so that these can be used for long interval of time under monitoring by an adaptive control system. This process enables machining of any material, which is electrically conductive, irrespective of its hardness, Shape or strength. The improvement of EDM have since then been intensely sought by the Manufacturing sector yielding enormous economic benefits and generating keen research Interests.

2. LITERATURE REVIEW

The literature towards the design methodologies proposed by different authors is collected and presented in the subsequent paragraphs.

S. Tripathy (2015)

Powder Mixed Electro-Discharge Machining (PMEDM) is a hybrid machining process where a conductive powder is mixed to the dielectric fluid to facilitate effective machining of advanced material. In the present work application of Taguchi method in combination with Technique for order of preference by similarity to ideal solution (TOPSIS) and Grey Relational Analysis (GRA) have been adopted to evaluate the effectiveness of optimizing multiple performance characteristics for PMEDM of H-11 die steel using copper electrode.

Lijo Paul (2016)

Electro Chemical Discharge Machining is one of the hybrid non-conventional machining process and it has wide scope for making intricate shapes in non-conducting materials. The mechanism of material removal in ECDM is thermal spark erosion (EDM) and chemical etching (ECM). Most of the researchers have used different base electrolytes – NaOH, KOH, NaCl etc for machining in ECDM process.

Chethan Roy (2016)

In the present work, a study has been made to optimize the process parameters of powder mixed electrical discharge machining (PMEDM). Response surface methodology has been used to plan and analyze the experiments. Analysis were done to investigate the effects of the process parameters viz. pulse current (I), pulse on-time (Ton) and concentration of the Al powder in kerosene dielectric (C) and its effects on material removal rate (MRR), tool wear rate (TWR) and surface roughness (Ra). Process parameters were optimized for high MRR, low TWR and low Ra using desirability function approach of MINITAB software.

3. ELECTRICAL DISCHARGE MACHINING (EDM):

Electrical discharge machining (EDM), also known as spark machining, spark eroding, burning, die sinking, wire burning or wire erosion, is a manufacturing process whereby a desired shape is obtained by using electrical discharges (sparks). Material is removed from the work piece by a series of rapidly recurring current discharges between two electrodes, separated by a dielectric liquid and subject to an electric voltage. One of the electrodes is called the tool-electrode, or simply the "tool" or "electrode," while the other is called the work piece-electrode, or "work piece." The process depends upon the tool and work piece not making actual contact.

3.1 Wire EDM

Wire-cut EDM (WEDM) is one of the most favorable variants owing to its ability to machine conductive, exotic and high strength and temperature resistive (HSTR) materials with the scope of generating intricate shapes and profiles. It uses a thin continuously traveling wire feeding through the work piece by a micro-processor eliminating the need for elaborate re shaped electrodes, which are required in the EDM. The Wire-Cut EDM process uses a thin copper wire of diameter about 0.1 to 0.3 mm as the electrode and the work piece is mounted on a CNC controlled worktable, enabling complex two dimensional shapes can be cut on the work piece by controlled the movement of the X-Y worktable.

3.2 Dry EDM

In this process a thin walled pipe is used as tool electrode through which high-pressure gas or a iris supplied. The role of the gas is to remove the debris from the gap and cooling of the inter electrode gap. The technique was developed to decrease the pollution caused by the use of liquid dielectric which leads to production of vapors during machining and the cost to manage the waste.

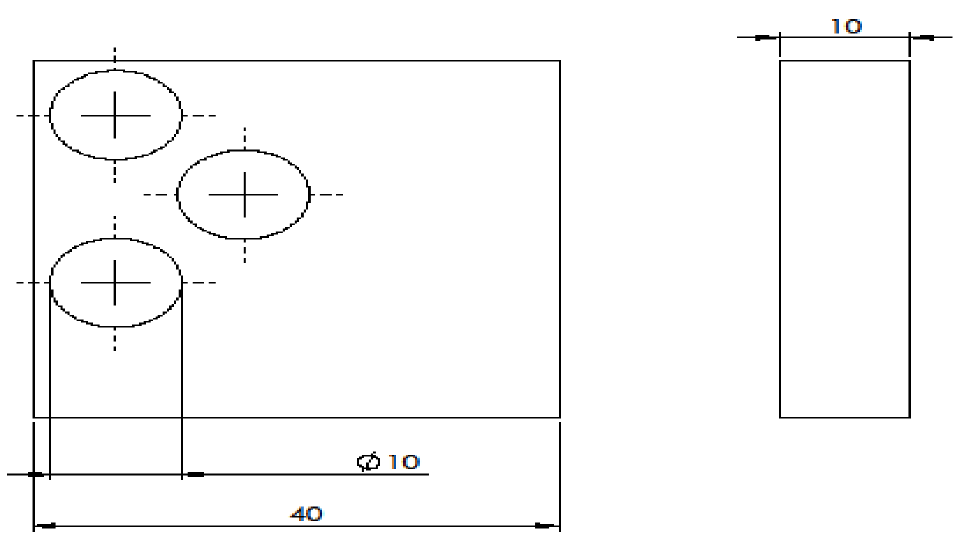
3.3 Powder Mixed EDM

The mechanism of PMEDM is totally different from the conventional EDM. A suitable material in the powder form is mixed into the dielectric fluid of EDM. When a suitable voltage is applied, the spark gap filled up with additive particles and the gap distance setup between tool and the work piece increased from 25–50 to 50–150 mm. The powder particles get energized and behave in a zigzag fashion Figure 8. These charged particles are accelerated by the electric field and act as conductors. The powder particles arrange themselves under the sparking area and gather in clusters. The chain formation helps in bridging the gap between both the electrodes, which causes the early explosion. Faster sparking within discharge takes place causes faster erosion from the work piece surface.

4. GREY RELATION ANALYSIS:

GRA is an important part of grey system theory pioneered by Professor Deng in 1982. A grey system means that a system in which part of information is known and part of information is unknown. With this definition, information quantity and quality form a continuum from a total lack of information to complete information – from black through grey to white. Since uncertainty always exists, one is always somewhere in the middle, somewhere between the extremes, somewhere in the grey area. Grey analysis then comes to a clear set of statements about system solutions. At one extreme, no solution can be defined for a system with no information. At the other extreme, a system with perfect information has a unique solution. In the middle, grey systems will give a variety of available solutions. Grey analysis does not attempt to find the best solution, but does provide techniques for determining a good solution, an appropriate solution for real world problems.

5. DIAGRAM:



6. OPTIMIZATION

LEVELS	PON	POFF	CURRENT
LEVEL 1	0.3792	0.39804	0.38139
LEVEL 2	0.3955	0.3725	0.4314
LEVEL 3	0.3761	0.38026	0.3379

Table 6.1 Level Vs Factor

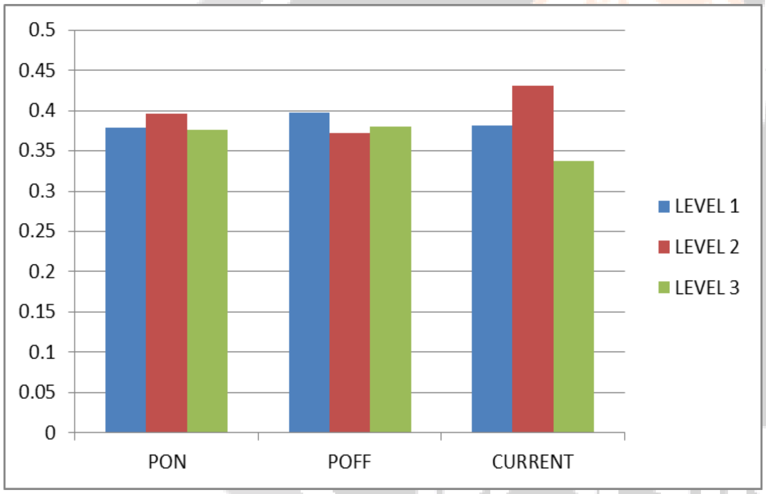


Fig 6.1.2 Level Vs Factor

6.1 OPTIMIZED VALUE

LEVEL 2	**0.5561**	**0.5006**	**0.5086**

7. CONCLUSION:

After analyzing the results of the experiments of OHNS tool steel with copper electrode, the following conclusions are arrived as follows

The increase in pulse current leads to a sharp increase in the material removal rate. And also it was observed that, tool wear rate are also increases with increasing the current. So, current was the most significant factor in both MRR and TWR. The increase in pulse on time leads to an increase in material removal rate and there is slight increase was observed with tool wear rate. The increase in pulse pause times both material rate and tool wear was decreasing

8. REFERENCE:

1.Shailesh Dewangan, Soumya Gangopadhyay, Chandan Kumar Biswas, 2015. "Multi-response optimization of surface integrity characteristicsof EDM process using grey-fuzzy logic-based hybrid approach", Engineering Science and Technology, an International Journal, 18: 361e368.

2. Milan Kumar Dasa, Kaushik Kumarb, Tapan Kr. Barmana and Prasanta Sahooa 2014 ."Application of Artificial bee Colony Algorithm for Optimization of MRR and Surface Roughness in EDM of EN31 tool steel", 3rd International Conference on Materials Processing and Characterization.

3. Dastagiri, M., A. Hemantha Kumar, 2014. "Experimental Investigation of EDM Parameters on StainlessSteel&En41b" 12th Global Congress on Manufacturing and Management.

4. Vikasa, Apurba Kumar Royb, Kaushik Kumar, 2014. "Effect and optimization of various Machine Process Parameters on the Surface Roughness in EDM for an EN41 Material using Grey-Taguchi" 3rd International Conference on Materials Processing and Characterization.

5. Durairaja, D., N. Sudharsunb, 2013. Swamynathan "Analysis of Process Parameters in Wire EDM with Stainless Steel using Single Objective Taguchi Method and Multi Objective Grey Relational Grade" ,International Conference On DESIGN AND MANUFACTURING. 6. Guu, Y.H., 2005. "AFM surface imaging of AISI D2 tool steel machined by the EDM process", Applied Surface Science, 242: 245-250. 7. Azadi Moghaddam, M., F. Kolahan, 2014. "Modeling and Optimization of Surface Roughness of AISI2312 Hot Worked Steel in EDM based on Mathematical Modelling and Genetic Algorithm" IJE.