Comparison: EDM and Powder Mixed EDM- A Review

P.V.DABHADE[#1], G.P.GAIKWAD[#2]

[#]Mechanical Department, Nutan Maharashtra Institute of Engineering & Technology(PCET) , Savitribai Phule Pune University, Pune, Maharashtra, India

Abstract- Nanofluid is a type of new engineering material which is made up of solid nanoparticles of the sizes of 1 to 100 nanometer dispersed in a base fluid. In this study Al2O3 nanofluid is synthesized and stabilized by using ultrasonic vibration and magnetic stirrer method. This each procedure used is for 2 hours. For this experiment Sodium dodecyl sulphate (SDS) which is used as a surfactant to provide better dispersion property to achieve stability for 4 to 5 days. From all the non-conventional machining methods, electric discharge machining (EDM) is most popular machining methods for the manufacturing. Powder mixed electric discharge machining (PMEDM) is one of the latest innovations for the improvement of capabilities of EDM process. In spite of different attempts Power Mixed Dielectric has the potential to increase efficiency of EDM in cost effective way. Taguchi technique is also been employed.

***Keywords*— Powder Mixed EDM (PMEDM), Material Removal Rate (MRR), Surface Roughness(SR), Stability ·**

I. INTRODUCTION

EDM is a non conventional machining and the basic principal of this is the conversion of electrical energy into thermal energy through a series of discrete electrical discharges occurring between the electrode (tool) and workpiece which is immersed in a dielectric fluid . Sparking starts when high voltage is applied between the electrode and workpiece at smallest distance. Metal starts eroding from both the surfaces of workpiece as well as electrode. After each discharge, the capacitor is recharged from the DC source through a resistor and the spark that follows is transferred to the next narrowest gap. At the end sparks spread on the whole work piece surface which leads to its erosion, or machining to a shape which is mirror image of the tool.

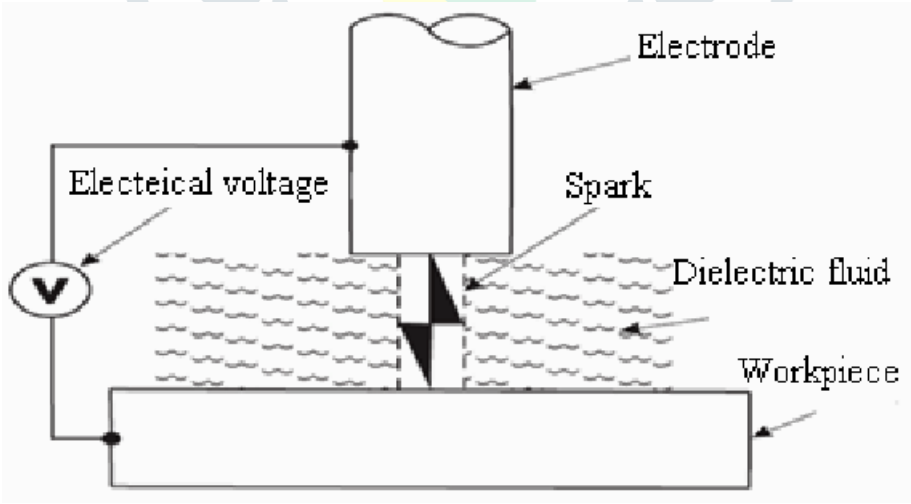

Figure 1. Spark initiation in EDM process

Powder mixed dielectric fluid in electrical discharge machining (PMEDM) is newly advance material removal process useful to increase the machining efficiency and surface finish. dielectric fluid which is powder particles mixed ,creates the faster sparking and increase the thermal conductivity, causing faster erosion from the workpiece surface and so the material removal rate (MRR) increases. The nano sized Al2O3 powder mixed dielectric fluid will change the surface roughness. A powder mixed dielectric is

upto 14% and 24% of the average surface roughness generated. The addition of nano particles in a dielectric fluid has also benefit in improving surface quality by removing micro-cracks.

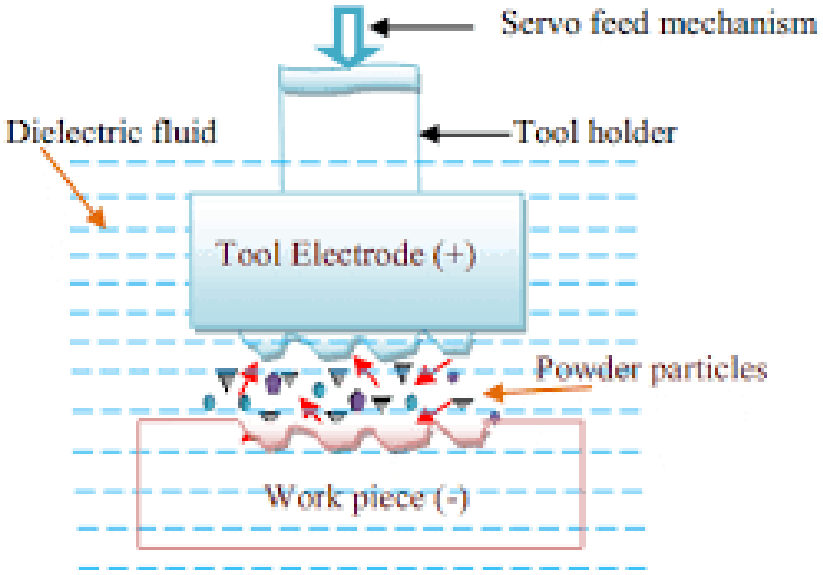

Figure 2. Spark initiation in PMEDM process

Electric discharge machining (EDM) is non conventional machining process used for machining complex machine materials such as heat treated tool steels, super alloys and carbides etc. In this process a pulse discharge occurs in a small gap between the work piece and the electrode and removes the unwanted material from the parent metal through melting and vaporizing. There is no direct contact between electrode and workpiece. Its unique feature of using thermal energy to machine electrically conductive parts regardless of hardness has been its distinctive advantage. It is commonly used in mould, die making industry and in manufacturing of automotive, aerospace components. The new hybrid material removal process is called Powder mixed EDM (PM-EDM). In PM-EDM a suitable metal powders such as Aluminium, Copper, Silicon etc. are mixed into the dielectric fluid. When a suitable voltage is applied between workpiece and tool, an electric field is generated. The added powder particles fill up the spark gap. It increases the spark gap. These high electric field energies powder particles. These particles act as conductors. These conductive particles form chains at different places under sparking area, which bridges the gap between tool electrode and work piece material. Due to this bridging effect, the gap voltage and insulting strengthof dielectric fluid reduces which facilitates easy short circuiting and hence early explosion in the gap between tool electrode and work piece material. Due to this, series discharges takes place within the gap. Due to increase in number of discharging per unit time, rapid sparking takes place that causes faster erosion from work piece surface. At the same time the added powder particles enlarged the plasma channel. Due to this, electric density decreases and therefore equal distribution of sparking takes place. This leads to uniform erosion on work piece which results in improvement in surface finish.

II. LITERATURE REVIEW

- R.Boopathi and S.Sundaram.[1] have studied,material removal rate (MRR) and tool wear rate (TWR) on the nano particle mixed electrical discharge machining of inconel 718 material using brass electrode and result shows that MRR gets improved and TWR gets reduced The current increases and material removal rate increase. The maximum material removal rate is increased with increase in current 15 amps.

- B .D.Kusure, Prof. P.K.Tamkhade et al.[2]have studied, Al2O3 nanofluid is stabilized and stabilised by using ultrasonic vibration and magnetic stirrer procedure. Each procedure is used for 2 hrs SDS sodium dodecyl sulphate (SDS) as a surfactant to provide better dispersion property.Maximum MRR is obtained at a high peak current of 18 A, Graphite as powder media. Low TWR is achieved at a current of 12 A, SiC as powder media.

- Khalid Hussain Syed , P. Kuppan [3] have studied, the effect of aluminium powder when mixed in the distilled water dielectric fluid. The work and tool electrode materials used are W300 diesteel and electrolytic copper respectively. Pulse peak current, pulse on-time and concentration of aluminium powder are taken as the process parameters. The result considered is white layer thickness (WLT).

- Ahmed A.D. Sarhan, Mohd Hamdi et al . [4] have studied, about enhancing the characteristics of AISI D2 steel surface machined with EDM through adding Ti nano-powder to dielectric under various different machining parameters,

including discharge duration (Ton) and peak current (I) to improve the MRR, to increase the surface finish.

- Hardaha Rajkumar, Manish Vishwakamra [5] have studied, Electrical discharge machining (EDM) is an Electro- thermal process with a complex metal-removal mechanism, involving the formation of a plasma channel between the tool and work piece in a dielectric fluid. Due to this, the process becomes more stable and its improve MRR and surface finish of work piece.

- S. Assarzadeh and M.Ghoreishi[6] have studied, neural network-by adding three types of powders separately into the dielectric fluid(kerosene) and comparison is been done between the results by three different powders.

- Rajiv Sharma and Jagdeep Singh [7] have studied, the concept and the process parameters in EDM for improvements in the process resulting in achieving desired quality levels.

- M. A. Razak, A. M. Abdul-Rani, and A. M. Nanimina[8] have studied, no.of techniques using Taguchi technique.

- Sharanjit Singh and Arvind Bhardwaj[9] have studied, the process of EDM in detail, the dielectric fluid used and its purpose.

- Gangadharudu Talla [10] have studied, to improve the productivity and surface integrity of machined surface of Inconel 625 (a nickel-based super alloy) by impregnating different powder particles in kerosene (dielectric fluid) during electric discharge machining (EDM).

- Shebin Thomas and Dr.S.Ramesh et.al [11] have studied, the input parameters of PMEDM by using taguchi technique.

- Sagar Patel , Dignesh Thesiya et al . [12] have studied, inspite of a range of different approaches Power Mixed Dielectric has the potential to improve the efficiency of EDM in cost effective way. Powder mixed electric discharge machining (PMEDM) is one of the innovations for the enhancement of capabilities of EDM process.

- Mahendra G. Rathi, Deepak V.Mane[13] have studied, the effect of Powder Mixed dielectric in EDM of Inconel 718 on various parameters by using TAGUCHI technique.

- Sravankumar Gudur, V V Potdar et.al[14] have studied, EDM adding Aluminium & Silicon powders into the various types of dielectric fluid during machining,characteristic of various materials have been studied.

- Ahmed Al-Khazraji ,Samir Ali Amin et.al [15]have studied, the difference between EDM and PMEDM and also studied the change in the white layer thickness(WLT).

- B. Purna Chandra Sekhar, S. Radhika, D. Sameer Kumar[16] have studied, the various trends in EDM process by using water and powder mixed dielectric as dielectric fluid.

- Sachin Mohal, Sandeep Singh Sangwan and Ramesh Kumar[17] have studied, the process parameters on the performance parameters.

- Mahammadumar M. Jamadar, M.V. Kavade [18] have studied, the effect of process parameters such as peak current (Ip), pulse on time (Ton) and Aluminium powder concentration on machining characteristics of AISI D3 die steel with round copper electrode.

- P. Srinivasa Rao, K. Eshwara Prasad[19] have studied, performing experiments with the outputs as material removal rate (MRR) and surface roughness (Ra). During the EDM, the discharge current was varied.

- BSV Ramarao, Dr. P Sailesh & Dr. M Sreenivasarao[20] have studied, the research work carried out in the improvement of PMEDM in the current condition for the improvement of machining characteristics such as Material Removal Rate (MRR), Surface Roughness (SR) and Tool Wear Ratio (TWR) when the commercial kerosene is used as a dielectric fluid with different powder materials.

III. CONCLUSIONS

MRR slightly increases , higher material removal rate in the surface .Tool removal rate is decreased. Different types of procedure required for nanomaterial stability, which provides more stability in less experimental time. The parametric study shows that, the WLT(White layer thickness) increases with increase in peak current for any value of the pulse on-time. Most of the available research works on powder-mixed dielectric have studied the impact of such machining on MRR, surface roughness

and TWR etc. Much investigation and more trails are needed to check the applicability and measure the performance of EDM with Powder particles in dielectric fluid.

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