Aspects of Wire Electric Discharge Machining: A Review

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Abstract:
Today's wire electrical discharge machines have many features and improvements from machines manufactured in the past. The main goals of wire electrical discharge machine manufacturers and users are to achieve a better stability and high productivity of the process, i.e., higher machining rate with desired accuracy and minimum surface damage. The complex and random nature of the erosion process in Wire electric discharge machining requires the application of deterministic as well as stochastic techniques. This paper is intended to give you a better understanding the aspects of wire electric discharge machining through literature review.

Key words: Electric, Accuracy, Frequency, conductive, Material

1 Introduction:

The Spark Theory on a wire electric discharge machining is basically the same as that of the vertical electric discharge machining process. In wire electric discharge machining, the conductive materials are machined with a series of electrical discharges that are produced between an accurately positioned moving wire and the work piece[1] High frequency pulses of alternating or direct current is discharged from the wire to the work piece with a very small spark gap through an insulated dielectric fluid [2]. A wire electric discharge machining generates spark discharges between a small wire electrode (usually less than 0.5 mm diameter) and a workpiece with deionized water as the dielectric medium and erodes the work piece to produce complex two- and three dimensional shapes according to a numerically controlled path [3]
The heat of each electrical spark, estimated at around 14,000° to 19,000° Fahrenheit, erodes away a tiny bit of material that is vaporized and melted from the work piece. These chips particles are flushed away from the cut with a stream of de-ionized water through the top and bottom flushing nozzle [8]. The water also prevents heat build-up in the work piece. Without this cooling, thermal expansion of the part would affect size and positional accuracy. The wire cut EDM uses a very thin wire 0.02 to 0.3 mm in diameter as an electrode and machines a work piece with electrical discharge like a bandsaw by moving either the work piece or wire. The merits of wire electric machine is that users are to achieve a better stability and higher productivity i.e., higher machining rate with desired accuracy and minimum surface damage. The wire EDM has four components such as [7]

(1) Computerized Numerical Control (CNC)
(2) Power Supply
(3) Mechanical Section
(4) Dielectric System

Literature Review of Wire Electric Discharge Machining:

The several authors have given the different reviews as under:

According to Mohapatra and Amar pattnaik (2006), the characteristics of wire electric machining refer essentially to the output machining parameters such as material removal rate, relative wear ratio and surface roughness. The machining parameters are the input parameters of the wire electric discharge machining namely electrode material ,polarity , pulse duration and pulse interval.

Accroding to Liao and Huang (1997) , studied the Surface roughness profiles with a stochastic modeling and analysis methodology to better understand the process mechanism. This mechanism shows the Scanning electron microscopic examination highlighted important features of Wire electric machined surfaces. Additionally, energy dispersive spectrometry revealed noticeable amounts of wire electrode material deposited on the workpiece surface.

Accroding to Mohd et al (2009), studied that the new computer-aided pulse discrimination system based on the characteristics of voltage waveform during machining .With the use of this system, a large amount of sparking frequency data during wire rupture process and under normal working conditions were collected and analyzed.

Accroding to Yan et al (2007) , studied that the attributes have their different performance when the influence of some attributes may be neglected. This may also happen if some performance attributes have a very large range. In addition, if the goals and directions of these attributes are different, this will cause incorrect results in the analysis.

Accroding to Lin, et al. (2002), studied that the current attempts to improve micro hole drilling. The focus is to develop a novel technique that enhances the capabilities of Micro-electric discharge machining for realization of micro holes with a high aspect ratio. Based on theories in fluidization engineering and ultrasonic degassing, a method of introducing ultrasonic vibrations into micro electric discharge machining processes is conceptualized and developed. A comparative analysis has revealed that the new technique can produce a significant increase in the aspect ratios over the current methods of micro hole drilling.

Accroding to Mu-Tian et al (2000) studied and summarized the basic concepts and applications of major methods of micromachining. The basic characteristics of each group of methods are discussed based on different machining phenomena. Capable methods are introduced in detail hinting at suitable areas of application.

Lee and Li (2001) have investigated the micro-electric discharge machining material removal characteristics using single RC-pulse discharges. They have reported that the estimated erosion efficiency of material removal at low-energy discharges is found to be seven to eight times higher than that at higher-energy discharges. They have also observed that the volume and size of the micro craters are more consistent at lower energy discharge than at higher energy discharges.

Yan et al. (2005) aims to show the prospects of EDM technology by inter relating recent achievements in fundamental studies on electric discharge machining with newly developed advanced application technologies. Although gap phenomena is very complicated and recent improvements in computers and electronic measuring instruments are contributing to new discoveries and inventions in the wire electric discharge machining technology.

Patil and Brahmankar (2006) investigates the manufacturing of micro-parts with an array of micro holes using the machined micro-graphite copper electrode in the electric discharge machining .This electrode is fabricated by using electrochemical process of anodic etching combined with electroforming process.

Manna and Bhattacharyya (2006) have studied on micro-hole machining of copper with traditional EDM machine using a tungsten carbide tool electrode. They reported that electrode wear and hole enlargement are both smaller, and a better profile of micro hole can be obtained when positive polarity machining is selected, however, electrode wear is higher when positive polarity machining is selected.

Liu et al. (2009) have used a helical micro-tool electrode to drill and finish micro-holes by using micro-electro-discharge machining combined with ultrasonic vibration. They have reported that this method can substantially reduce the Wire electric discharge machining gap, taper and machining time for deep micro-

hole drilling. Moreover, using a helical micro-tool with micro ultrasonic vibration finishing, good surface quality can be obtained.

Conclusion:

The Wire electric discharge machining has proved to be an appropriate nonconventional machining method for manufacturing accurate and complex three-dimensional structural micro-features which are difficult to be produced by conventional processes. However, the miniaturization of the wire electric discharge machining process needs special requirements on the machining equipment. This research paper has shows the different aspects of wire electric discharge machining by the literature review.

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