A RECENT REVIEW ON MICRO ELECTRO DISCHARGE MACHINING PROCESS

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Abstract The main focus of this paper is studying recent researches on Micro EDM done by various authors. The different experimentation and the methodology in Micro EDM are explained. The performance of Micro EDM for various experiments is discussed. From this paper, one can infer the knowledge of how to improve the performance characteristics of Micro EDM using different experimental analysis.

Index Terms **– EDM, Micro-EDM, Cold plasma jet, Electrode length**

I. INTRODUCTION

Micro EDM is the advanced machining process which is based on the thermo-electric energy between tool and work material. It is a new development of EDM process to produce micro parts in the range of 50 µm to 100 µm. It is efficient for machining of micro metal hole. The Micro EDM is able to machining of materials that possess high strength, high toughness and high melting point such as Inconel, titanium alloy, nickel based alloys and other super alloy etc.

II. LITERATURE REVIEW

In this chapter, different experimental analysis and its results of various authors are studied. The concept and research work of various topics regarding Micro EDM are discussed and the experimentation methodology are explained.

Richard et al. [1]: This paper investigates the relation between electrode profile and tool-path trajectory and also demonstrate the link between wear, trajectory and electrode profile by experimental analysis. It describes the electrode profile for cylindrical shape electrode with a trajectory in full material, is conically self-shaped and for zigzag pocketing trajectory the self-shaped profile is more complex but linked with the tool-path over-lap in a predictable way (i.e. it depends upon the volumetric wear, the tool-path overlap, tool-path steepness and the gap between tool and work material). It is found that the EDM gap has more effect to make the electrode's profile more flat. For the micro-EDM-milling the electrode diameter < 0.3mm this which leads the electrode profile tends to be cylindrical and makes much easier the tool-path strategy and electrode wear compensation algorithm. From the analysis it is determined that the wear to tool-path trajectory, the EDM gap and the initial material repartition which are relating the electrode profile in both EDM-milling and micro-EDM-milling. It is inferred that nevertheless, in any chosen conditions the electrode profile tends to be cylindrical. It is found that the transitory stage which makes the process difficult to manage can be avoided.

Chengyang et al. [2]: This paper is the study of characteristics of micro electrical discharge machining (EDM) in cold plasma jet by using transistor pulse generator. The oxygen-assisted nitrogen plasma jet, nitrogen-oxygen mixed plasma jet and external compressed air assisted nitrogen plasma jet are used in micro-EDM experiments to improve the processing efficiency and quality in stable process conditions. It is found that the increase of oxygen flow rate in oxygen-assisted nitrogen plasma jet experiment leads to increase of the material removal rate and surface roughness. It is found that micro-EDM with a compressed air-assisted plasma jet is superior to oxygen-assisted nitrogen plasma jet in surface quality and edge quality. It is inferred that the nitrogen element is not found on the machined surface in micro-EDM based on NPJ or NJ and the content of oxygen element has increased when compressed air is used as an auxiliary gas.

Modica et al. [4]: This paper has studied the performance of micro-electro-discharge machining (micro-EDM) process using different flushing medium such as deionized water, tap water, deionized water with Garnet, tap water with Garnet. There were several tests has been performed by considering a hardened steel thin work piece machined in micro-EDM drilling and through-trench. The Garnet is the abrasive material exploited in the micro-Abrasive Water Jet. The concentration per liter of water is the same as required in micro-abrasive water jet machining. A system has been built on micro-EDM Sarix SX 200 HP machine which is customized to allow the water-based fluid refill and liquid level monitoring during the experiments. The experiment trials have been carried out by considering two machining regimes, roughing and semi finishing. The different water-based fluids have different electrical conductivities, which lead to different machining performance. The Material removal rate and tool wear ratio are estimated in terms of average and standard deviation. It is inferred that the presence of Garnet does not affect MRR

consistently. The reason is that the particles do not play an active role in the erosion process but affect surface quality that determined by the inspection of crater morphology and dimensions estimation performed using confocal microscope. It is identified that the Material removal rate is generally increased as the conductivity decreases particularly when semi-finishing regime is used and Tool wear rate decreases dramatically while using water-based fluids due to the formation protective recast layer is also deposited on the tool tip. This analysis proved that the micro-EDM can be successfully performed using the same liquid used in micro-Abrasive water jet.

Grzegorz et al. [8]: The paper focused on analyzing the characteristics of micro drilling in the stainless steel samples depending on the electrode tool length (distance from machined surface to tool electrode clamp). The tool wear ratio, material removal rate / machining efficiency and machining accuracy / quality are compared. The micro EDM drilling experiments were performed for tool electrode of 0.1 mm diameter and work pieces of 1 mm thickness and the concerned result are presented. The conclusions on process optimization and process planning for cost and time effective machining are derived. The machining time, electrode tool re-clamping time has taken in to account. It is determined the time-effective machining regime is not equal to the cost-effective machining from the presented results. From the analysis it is suggested to keep the electrode as short as possible to perform micro drilling of holes to minimize the harmful effect of the forces generated due to discharges during machining process.

III. CONCLUSION

From the above papers and its experimental results, the various performance characteristics of Micro EDM is studied and discussed. It is inferred that the electrode profile depends upon the volumetric wear, the tool-path overlap, tool-path steepness and the gap between tool and work material. It is proved that the increase of oxygen flow rate in oxygen-assisted nitrogen plasma jet experiment leads to increase of the material removal rate and surface roughness. It is determined that the Material removal rate is generally increased as the conductivity decreases particularly when semi-finishing regime is used and Tool wear rate decreases dramatically while using water-based fluids due to the formation protective recast layer is also deposited on the tool tip. It is suggested to keep the electrode as short as possible to perform micro drilling of holes to minimize the harmful effect of the forces.

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