Research Paper Engineering

Electric Discharge Diamond Drilling: Design and Development of setup

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ABSTRACT

There still exist numerous difficulties in generating holes in super alloys, advanced materials and metal matrix composite materials. Electro-discharge drilling (EDD) is a proficient drilling process for the hole making and hole grinding resulting from its characteristics of being a conductive and a thermal process. The EDD process has been investigated and found that this type of process is generally unstable, but its efficiency is very high. The process parameter has been compared with EDM process. In this paper we have research to use a hybrid machining process for producing holes in different alloy material (ex- nickel based alloy).and named it as electric discharge diamond drilling. For this process we have self designed and developed set up which can easily hold and rotate the metal bonded diamond abrasive tool as electrode. We have installed this set up on NC 200 electric discharge machine and we will perform the experiment.

KEYWORDS : EDDD Setup, diamond, MRR

INTRODUCTION

Electrical Discharge Machine (EDM) is now become the important accepted technologies in manufacturing industries since many complex 3D shapes can be machined using a simple shaped tool electrode. Electrical discharge machine (EDM) is an important 'unconventional manufacturing process', developed in the late 1940s and has been accepted worldwide as a standard processing manufacture of forming tools to produce plastics moldings, die castings, etc. New developments in the field of material science have led to new engineering metallic materials, composite materials, and high tech ceramics, having good mechanical properties and thermal characteristics as well as sufficient electrical conductivity so that they can readily be machined by spark erosion.

At the present time, Electrical discharge drilling machine (EDDM) is a popular technique used in industry for high precision machining of all types of conductive materials such as: metals, metallic alloys, graphite, or even some ceramic materials, of whatsoever hardness. Electrical discharge drilling machine (EDDM) technology is increasingly being used in tool, die and mould making industries, for drilling of heat treated steels and advanced materials (super alloys, ceramics, and metal matrix composites) requiring high precision, complex shapes and high surface finish. Traditional machining technique is often based on the material removal using tool material harder than the work material and is unable to machine them economically.

An electrical discharge drilling machining (EDDM) is based on the eroding effect of an electric spark on both the electrodes used. Electrical discharge drilling machining (EDDM) actually is a process of utilizing the removal phenomenon of electrical-discharge in dielectric. Therefore, the electrode plays an important role, which affects the material removal rate and the tool wear rate.

EDM has different way to machine, like, Sinking, cutting and grinding etc. Electric discharge drilling is based on the sinking principle in which drill works as a sink die in the form of hole (cylindrical). Die sinking is a common engineering application of EDM, and the drilling of fine holes and the machining of complicated shapes on thin fragile materials are other typical applications. The EDD is not limited to the use of only one electrode at a time for drilling of holes but also quite a large number of small holes can be drilled simultaneously. Electrical discharge drilling as applied to drilling small holes is used more and more in the aerospace, automotive, tool and die, and other industries for producing cooling channels in parts made of hard materials. Electrical discharge drilling as applied to drilling small holes is used more and more in the aerospace, automotive, tool and die, and other industries for producing cooling channels in parts made of hard materials.

In simple electric discharge drilling, there are some drawbacks present like, low material removal rate, more tool wear etc. to overcome these drawbacks we have develop own set up which machine the work by electric erosion and conventionally also it increases material removal rate. For fulfill the objective we use diamond grains on simple electrode tool. The diamond cut the work conventionally. For this purpose we rotate the diamond coated tool by some mechanism. This mechanism is our set up which can rotate individually from spark gap feed.

2. METHODOLOGY:

Fig 1: Flow chart of methodology

In Conducting Literature Review we found that Bhattacharyya et al. (1981) derived correlations between pulse on-time and current on the machinability parameters such as material removal rate, electrode wear, overcut, surface finish and surface integrity. Jain (1989) and Indurkhya et al. (1990) investigated electric discharge drilling of blind holes in high speed steel using bit type tools. Sato et al. (1986) developed an electro discharge machine to bore micro holes, 15 – 30 µm in diameter with high precision. Yan et al. (1999) investigated the effect of EDM process parameters on the quality of the micro-hole in carbide work piece using copper electrode

We have analyzed the parameters of EDM process. The parameters are discharge current, pulse on time, pulse off time, material removal rate, surface roughness, tool wear rate and collect some data based on previous experiment and literature review.

After analyzing parameters in previous experiment we founding Gaps in the past work, less material removal rate are found in electric discharge drilling machine. It also found that more tool wear rate is found during the process. All the electric discharge drilling processes use electric spark erosion for machining. That is why we fill the gap in past work and we have developed hybrid machine setup.

Design of set up:-

- Design of Shaft
- Design of Belt and pulley
- Design of bearing
- Electric motor
- Modeling of setup by solid works
- Design of Electrode (tool)

Development of setup

In fabrication of setup, operations have been done on different machines. In an EDDD setup attachment we use mild steel U shape angle plate of dimensions 190x112 mm^2 with flange 112x110 mm^2. Hole is provided in flange of 25+mm diameter.

Shaft of stainless steel-304 is taken for holding and rotating tool because it is highly corrosive resistant. Two bearings are fitted on the shaft of 25 mm diameter. Bearing inner diameter is also 25 mm and outer diameter is 62 mm. To support the bearing, bearing covers are used. The covers are bolted on the flange of angle plate.

Pulley is fitted on the top of the shaft and tool holder fitted at the bottom of the shaft.

A support L-shape angle plate is used to attach the motor and angle plate. This L-shape angle plate is to be mounting on the ram of EDM.

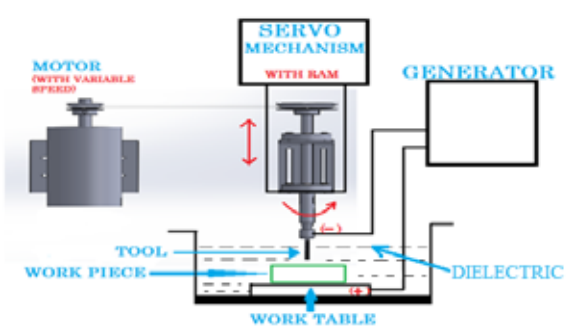

Fig 2: Block diagram of EDDD setup

COST ANALYSIS:-

S.No.	Component	No. of pieces	Cost (Rs.)	Description
1	Shaft	1	600	Stainless steel-304
2	Bearing	2	550	SKF-6305
3	Pulley	2	200	Cast iron
4	Tool holder	1	520	Self centered
5	Motor with controller	1	10000	0.5 hp, 1700 rpm
6	Belt	1	100	V- belt
7	Weighing Machine	1	1000	Least count-0.01g
8	Machining & Fabrication cost	-	3400	Along with angle plate ,bearing cover

Table 1: Cost Estimation of setup

CONCLUSION

The following conclusions can be drawn from the present investigation:

For the purpose of EDDD process, a compensation scheme has been proposed and introduced, it has been demonstrated that the scheme is successfully applied to the actual hole drilling.

EDD setup has been developed to increase the material removal rate of the hard materials.

The MMR for EDM process is very less as compared to EDD process and TWR for EDD process is also low as compared to simple EDD process.

The developed set up can be used to further investigate the machining behavior of other hard to machine alloys and composites.

FUTURE AND SCOPE OF WORK

By using hybrid machining process we can involve more than one types of mechanism in machining.

We can use different size of tool to produce different types of holes in very rapid manner.

We can use different types of hard materials of grains at the place of diamond.

We can use different size of grains to produce better surface finish.

We can reduce tool wear rate and increase the MRR by this hybrid machining.

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