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A STUDY AND INVESTIGATION ON SR IN WIRE ELECTRICAL DISCHARGE MACHINING USING TRIM CUT STRATEGY

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Abstract: Wire electrical discharge machining process is a very unpredictable, time differing stochastic process. The process output is affected by astronomically immense no of input variables. In this manner an appropriate choice of info factors for the wire electrical release machining (WEDM) prepare depends vigorously on the operator's innovation and experience on account of their various and differing range. By the study of the Trim cut strategy in wire EDM machining lead to us well developed manufacturing process. By control of the surface integrity it impact on the end product. Mostly the surface integrity control required in the die manufacturing where precision is important because of it directly impact on the end products. In this study we observe the surface parameter after WEDM machining on titanium and SAILMA 350HI. The study demonstrates that the WEDM process parameters like pulse on time, pulse off time, wire feed rate, servo voltage, peak current can be adjusted so as to achieve better surface finish.
Keywords: Wire EDM, Surface roughness, Trim Cut, Main Cut

I. INTRODUCTION

Non-conventional machining processes are called advanced manufacturing processes since they are established in modern industries. These machining processes are fulfilled by various energies such as mechanical, thermal, electrical or chemical or combinations of these energies to remove extra material.

In Traditional machining processes such as drilling, shaping, turning, and milling are not utilize to machine extremely hard and brittle materials. Many difficulties arise in traditional machining processes. The machining processes described in the previous lines are involved material Removal by mechanical means: chip formation, abrasion, or microchipping. [1] Electrical discharge machining (EDM) is a non-conventional machining concept which has been widely used to produce dies, moulds and metal-working industries. This technique has been developed in the late 1940s and has been one of the fast increasing methods in developed area during 1980s and 1990s. This machining method is commonly used for very hard metals that would be impossible to machine with conventional machine. It has been widely used, especially for cutting complicated contours or delicate cavities that also would be tough to produce with conventional machining methods. However, one critical limitation is that EDM is only works with electrically conductive materials. The world's first WEDM was produced by the SWISS FIRM 'AGIE' in 1969. The first WEDM machine worked simply without any complication and wire choices were limited to copper and brass only. Several researches were done on early WEDM to modify its cutting speed and overall capabilities. In recent decades, many attempts were done on Wire EDM technology in order to satisfy various manufacturing requirements, especially in the precision mold and die industry. Wire EDM efficiency and productivity have been improved through progress in different aspects of WEDM such as quality, accuracy, precision and operation. [2] A variation of EDM is wire EDM (Fig. 1), or electrical-discharge wire cutting. In this process, which is similar to contour cutting with a band saw a slowly moving wire travels along a prescribed path, cutting the work piece. This process is used to cut plates as thick as 300 mm and to make punches, tools, and dies from hard metals. It also can cut intricate components for the electronics industry. Fig. 1 shows a thick plate being cut by this process. The method of material removal in wire electrical discharge machining is as like to the conventional electrical discharge machining process concerning the erosion effect on work piece by the spark. In wire electrical discharge machining, material is eroded from the work piece by a cycle of spark occur between work piece and wire which is separate by Dielectric liquid, which is continuously fed to the machining zone. [1]

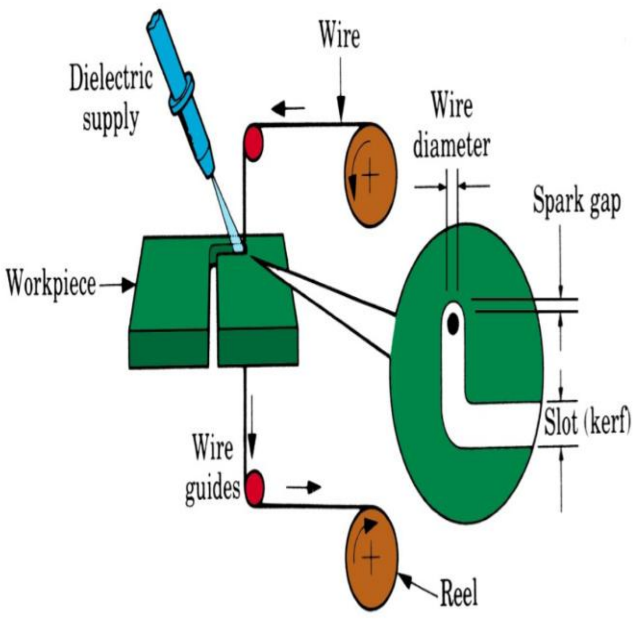

Fig 1: Wire EDM Process [1]

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II. SURFACE INTEGRITY

Surface integrity is a generalize term which means the surface condition of a workpiece after being modified by a manufacturing process. The term was coined by Michael Field and John F. Kahles in 1964. [3] It can be controlled in the respect of the parameter Surface Roughness, Surface Roughness is the properties of the material which shows the smoothness of the metal, and how precision cutting is carried out in the material. Therefore one term trim cut strategy is carried to increase the surface roughness of the material. We can go for one, two or more trim cut as per requirement. But increasing the trim cut doesn't affect much more the surface roughness while obtaining the surface roughness in first trim cut.

III. LITERATURE REVIEW

M.T. Antar et al [4] shows the effect on parameter by using of two different wires coated and uncoated. They stated that in wire EDM process they have use coated and uncoated wire for machining of the Udiment 720 nickel based alloy and Ti-6Al-2Sn-4Zr-6Mo titanium alloy. They concluded that by using of coated wire (ZnCu50 and Zn rich brass) productivity (70% in titanium alloy and 40% in Udiment 720) increase by using of the coated wire in comparison of uncoated brass wires with the same parameter. They also concluded that by using of coated wire in recast layer they get better result in both condition like rough (main cut) and trim cut operation.
Kamal Kumar Jangra et al [5] carried out an experimental studies of rough and trim cutting operation in wire electrical discharge machining (WEDM) on four hard to machine materials namely WC-Co composite, HCHCr steel alloy, Nimonic-90 and Monel-400. They investigate that in rough cutting operation, machining speed and surface roughness increases with increasing discharge energy across the electrodes. They performed trim cutting operation at similar discharge parameters but with different wire offset were performed for four work materials. They find out that using single trim cutting operation with appropriate wire offset, surface characteristics can be improved irrespective of the rough cutting operation. They also notice that multi trim cut is not much effective in terms of the surface characteristics like surface roughness.

IV. EXPERIMENT

The experimental setup and the experiment is designed with the primary goal of the dissertation work is to predict the surface roughness. The work is carried out in sprint cut wire cut electro discharge machine of HCHCR and Titanium material by varying machining parameters. The machine used for experiments is Electronica sprint cut Wire cut EDM, Model- ELPULS-40 A DLX, incorporated with molybdenum wire technology. The input and fixed parameters used in the present study are also listed in Table 1.and Table2 respectively. These were chosen through review of literature, experience, and some preliminary investigations. Different settings of Pulse On Time (µs), Pulse Off Time (µs), Servo Voltage (volt), Wire Feed Rate (m/min) used in experiments.

Table 1: Input variable with level value

Sr. No.	Machining process parameter	Level 1	Level 2	Level 3
1.	Wire Feed Rate (m/min)	6	8	-
2.	Pulse On Time (µs)	110	115	120
3.	Pulse Off Time (µs)	50	55	60
4.	Peak current(Amp)	120	140	160
5.	Servo Voltage (volt)	15	20	25

Table 2: Fixed Parameter

Sr. No.	Fixed Parameters		
1.	Work Material	TITANIUM	SAILMA 350HI
2.	Wire Tension(Kg)	0.8	0.8
3.	Flushing Pressure(Kgf/Cm2)	1	1
4.	Servo Feed Setting	130	250
5.	Dielectric Fluid	Dionized water	Dionized water

Total 9 experiments carried out in this experiment. Now by took experiment on the wire EDM machine with trim cut strategy we get the following result, which is shown in the table 3 and 4.

Table 3: Result Table for Surface Roughness for Sailma 350Hi

Sr. No	Wf (m/min)	Ton (µs)	Toff (µs)	Ip (amp)	Sv (volt)	SR(MC) (µm)	SR(TC) (µm)
1	6	110	55	140	20	2.2012	1.6235
2	6	115	55	140	25	3.1012	2.5080
3	6	115	60	160	15	3.1618	2.5392
4	6	120	55	160	20	3.3212	2.6925
5	6	120	60	120	25	2.5325	1.7853
6	8	110	55	120	15	2.2052	1.5753
7	8	115	55	160	15	3.3152	2.6293
8	8	115	60	120	20	2.3912	1.6923
9	8	120	55	120	25	2.8512	2.1214

Table 4: Result Table for Surface Roughness for Titanium

Sr. No	Wf (m/min)	Ton (µs)	Toff (µs)	Ip (amp)	Sv (volt)	SR(MC) (µm)	SR(TC) (µm)
1	6	110	55	140	20	2.4032	1.7523
2	6	115	55	140	25	3.1134	2.4023
3	6	115	60	160	15	3.2898	2.4135
4	6	120	55	160	20	3.3395	2.6534
5	6	120	60	120	25	2.8332	1.9925
6	8	110	55	120	15	2.4089	1.7269
7	8	115	55	160	15	3.3758	2.4372
8	8	115	60	120	20	2.5243	1.8567
9	8	120	55	120	25	2.989	2.1912

V. RESULT AND DISCUSSION

Surface Roughness for Sailma-

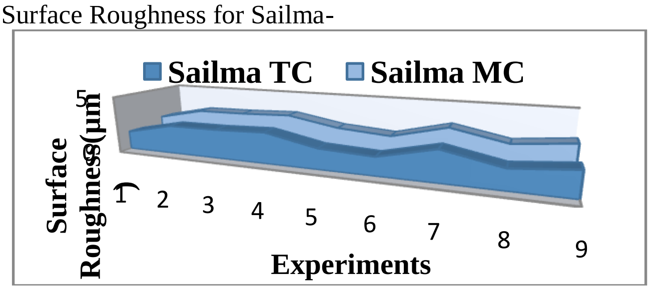

Fig. 2: Surface Roughness for Sailma

In figure 2 comparison of the surface roughness of main cut and trim cut of Sailma material by wire EDM is shown. Figure shows that we get better surface roughness in trim cut operation. We get about 30to 50% finish surface after first trim cut which is shown in figure 2.

Surface Roughness for Titanium-

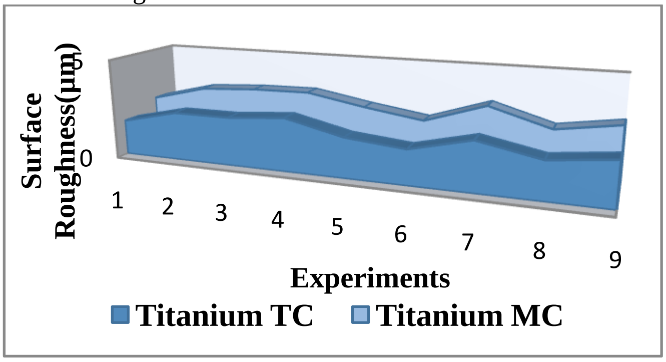

Fig. 3: Surface Roughness for Titanium

In figure 3 comparison of the surface roughness of main cut and trim cut of Titanium by wire EDM is shown. Figure shows that we get better surface roughness in trim cut operation. We get about 30to 50% finish surface after first trim cut which is shown in figure 3.

VI. CONCLUSION

In this work an attempt was made to consider the effects of Surface roughness (µs), with trim cut strategy is carried out in WEDM. Above analysis shows that with same parameter in main cut can be utilized for trim cut and it gives better surface roughness. From main cut to trim cut there is 30 to 50% increasing surface roughness for both materials.

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