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EFFECTS OF PROCESS PARAMETERS IN WIRE CUT EDM ON MATERIAL REMOVAL RATE OF ALUMINIUM COMPOSITE

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Abstract: This paper deals with the machining characteristics of wire cut electrical discharge machining process in Al7003 alloy and Al7003-TiO_2 composite material. The effects of various process parameters of wire cut electrical discharge machining like pulse on time, pulse off time, servo voltage, wire speed, discharge current(IP amp), servo feed(mm/min) have been investigated to reveal their impact on material removal rate of Al7003 alloy and Al7003-TiO_2 composite using one variable at a time approach. The optimal set of process parameters has also been predicted to maximize the material removal rate.

Keywords: WEDM, T_{ON}, T_{OFF}, SV, WF, MRR

1. INTRODUCTION

Wire Electrical discharge machining (WEDM) is a nontraditional, thermoelectric process which erodes material from the work piece by a series of discrete sparks between a work and tool electrode immersed in a liquid dielectric medium, these electrical discharges melt and vaporize moment measures of the work material, which are then catapulted and flushed away by the dielectric. The schematic representation of the Wire electrical discharge machining cutting process is shown in Figure 1. Wire electrical discharge machining is a specialized thermal machining process capable of accurately machining parts with varying hardness or complex shapes, which have sharp edges that are very difficult to be machined by the main stream machining processes. At present, Wire electrical discharge machining is a widely used in the aerospace and automotive industries for high-precision machining of all types of materials such as metals, metallic alloys, graphite or even some ceramic materials of any hardness.

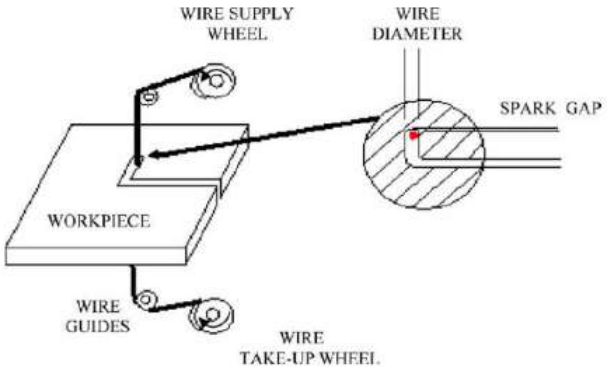

Fig. 1. Schematic representation of wire EDM process

2. EXPERIMENTAL METHODOLOGY

The experimental studies were performed on WEDM machine (Figure 2). Brass wire of 0.25 mm diameter is used as a tool electrode and distilled water as dielectric fluid were used in the experiment. Various input parameters varied during the experimentation are pulse on time, pulse off time, servo voltage, wire feed. The effects of these input parameters were studied on material removal rate using one factor at a time approach. The units of some input parameters such as pulse on time, pulse off time, servo feed, wire feed were taken as per the machine setting.

Fig.2. WEDM machine

Different settings of open circuit voltage, wire speed and dielectric flushing pressure were used in the experiments. During the experiments, two input variables discharge current (IP) and servo feed were kept constant. In each experiment one input variable was varied while keeping all other input variables at some mean fixed value and the effect of change of the input variable on the output characteristic i.e. material removal rate is studied and reported in this paper. The work piece materials of Al7003 alloy and Al7003-TiO_2 composite material of diameter 25mm and length 250 mm were used. To evaluate the effects of machining parameters on performance characteristic (MRR) and to identify the performance characteristics under the optimal machining parameters.

3. RESULTS AND DISCUSSIONS

The experiments are based on one factor experiment strategy. In this only one input parameter was varied while keeping all other input parameters at constant values. During this experimental procedure, three sets of experiments were performed. The results of the following were obtained.

3.1The effect of Servo voltage on the material removal rate when Pulse on=1µs and Pulse off =16µs is shown in fig 4

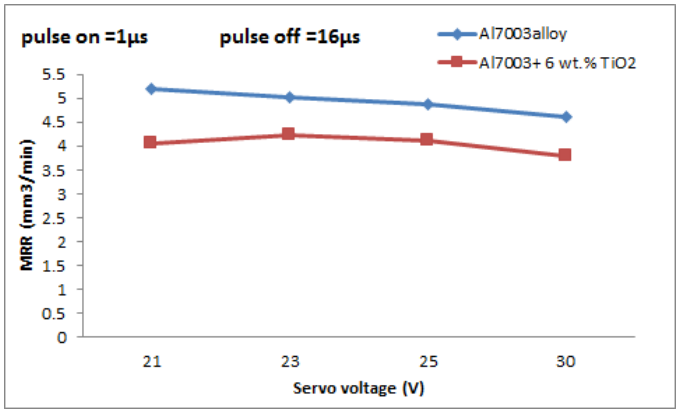

Fig 4. Variation of MRR on Servo voltage of wire cut EDM

3.2 The effect of Servo voltage on the material removal rate when Pulse on =1µs and Pulse off =17µs is shown in fig 5.

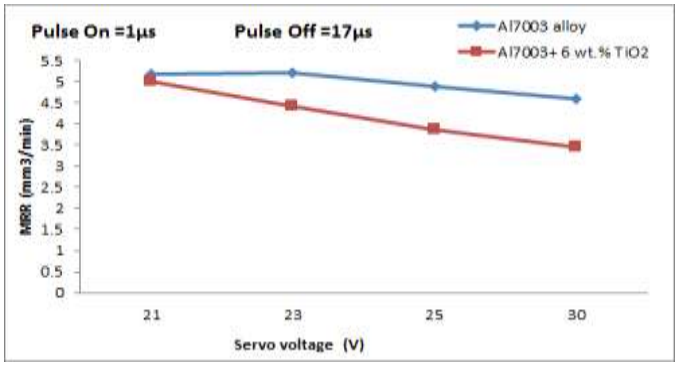

Fig 5. Variation of MRR on Servo voltage of wire cut EDM

In the above Fig 4 and Fig 5, graph reveals that the material removal rate decreases with increase in the Servo voltage (V). The material removal rate is higher at low voltage and lower at high voltage.

3.3 For the second set of experiments the effect of pulse on time on material removal rate when pulse off=14µs and servo voltage= 25V is shown in fig .6

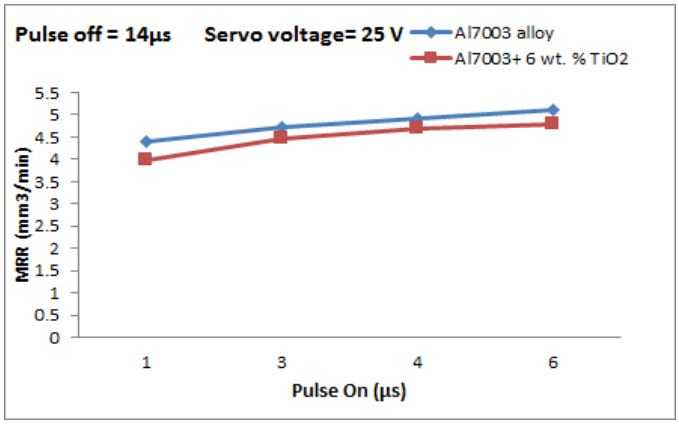

Fig 6. Variation of MRR on Pulse on of wire cut EDM

3.4 The effect of pulse on time on material removal rate when pulse off =14µs and servo voltage= 30V is shown in fig .7

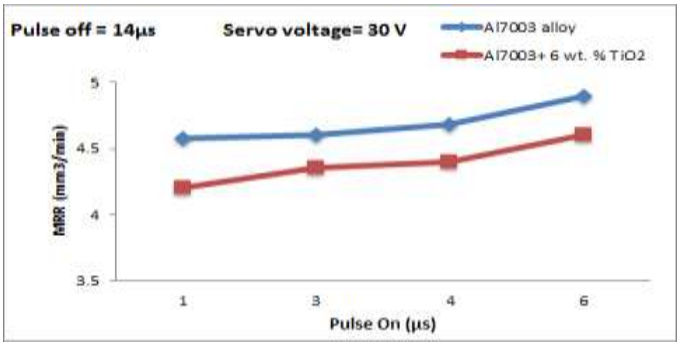

Fig 7. Variation of MRR on Pulse on of wire cut EDM

In the above Fig 6 and Fig 7, graph shows that material removal rate increases with the increase in the pulse on time. So the pulse on time can be adjusted to get the desired material removal rate.

3.5 For the third set experiments the effects of Pulse off time on material removal rate when Pulse on = 4µs and servo voltage= 30V is shown in fig 8.

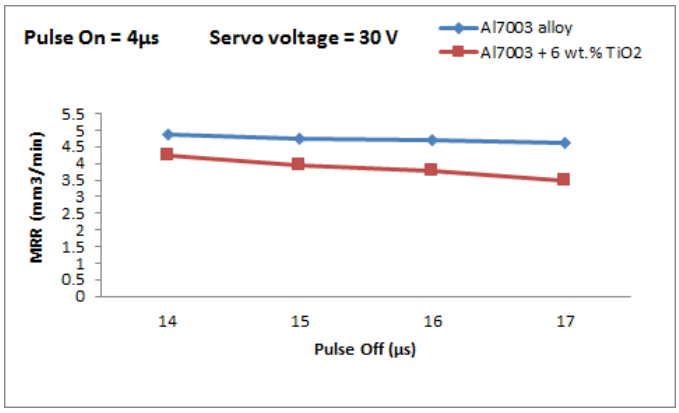

Fig 8. Variation of MRR on Pulse off of wire cut EDM

3.6 The effects of Pulse off time on material removal rate when Pulse on = 6µs and servo voltage= 30V is shown in fig 9.

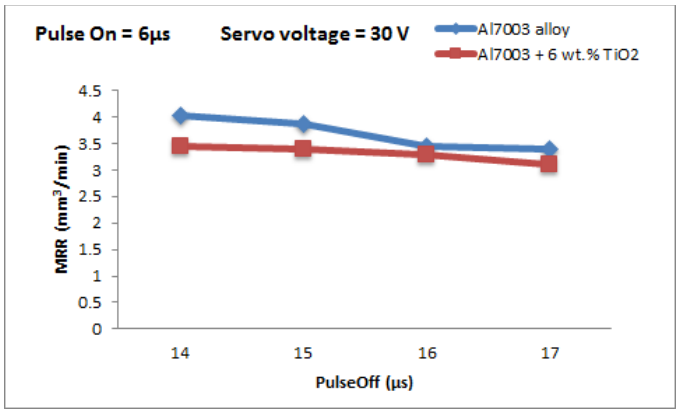

Fig 9. Variation of MRR on Pulse off of wire cut EDM

In the above Fig 8 and Fig 9, graph shows that the material removal rate decreases with increase in the Pulse off time. So the value of Pulse off time can be selected in such a way that we get the desired material removal rate.

4 CONCLUSIONS

1. Material removal rate of both the Al7003 alloy and Al7003+ 6 wt. % TiO_2 composite material decreases as the servo voltage increases.
2. Material removal rate of the Al7003 alloy and Al7003+ 6 wt. % TiO_2 composite material increases with increases in Pulse on time (T_{ON}), the Pulse on time parameter has direct effect on the material removal rate.
3. When the Pulse off time (T_{OFF}) is increased the material removal rate is decreased.

It can be concluded that the material removal rate (MRR) of Al7003 alloy and Al7003+ 6 wt. % TiO_2 directly increases with increase in Pulse on time while decreases with increase in Pulse off time and Servo voltage.

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