CHAPTER 4

PRELIMINARY INVESTIGATION OF MACHINABILITY OF C-SiC USING EDM

4.1 Introduction

Nontraditional processes of manufacturing have experienced steady growth since their introduction. An increased growth rate for these processes in future is assured because nontraditional processes currently possess unlimited capabilities when compared with conventional processes, except for volumetric material removal rates. Many of these processes are available with computer controls so that even unfamiliar people can use these machines and this feature has accelerated acceptance, and also assured reliability and repeatability.

4.2 Experimental Work

4.2.1 Workpiece Material

The workpiece material is a ceramic composite C-SiC material as shown in Figure 4.1.
4.2.2 EDM Machine

The machine used is Elektra EDM from Electronica. The machine is NC controlled in the Z-direction. The di-electric fluid used was kerosene. The electrode used was electrolytic copper 1.6 mm diameter as shown in Figure 4.2

4.3 Experimental Procedure

4.3.1 Experiment 1

1. The machining parameters selected for machining are pulse current = 25A, gap voltage = 50 volts and pulse on time = 2 pulses.
2. The machining parameters selected for machining are pulse current = 40A, gap voltage = 60 volts and pulse on time = 300 seconds.

3. The machining parameters selected for machining are pulse current = 40A, gap voltage = 60 volts and pulse on time = 300 seconds. An aluminium sheet 1 mm thick was introduced just above the ceramic specimen.
4.3.2 Experiment 2

Workpiece Material - Initial sample size: 12.5 x 2.6 x 6 mm after polishing the top surface as shown in Figure 4.6

1. The parameters set on the EDM were pulse current 6A, pulse on time 500, gap voltage 55V, the top layer of the work piece was only machined and frequent short circuit stopped the machine. After 1 hour the parameters were changed to pulse current 9A, pulse on time 750 and pulse voltage 100.

2. The parameters set on EDM machine were pulse current 9A, pulse on time 750 and pulse voltage 100 machining in progress is shown in Figure 4.7.

4.4 Observations

4.4.1 Observations - Experiments 1

1. As the electrode of the EDM machine is brought down for referencing and inspite of having NC control in the Z-direction the ceramic composite breaks down. The breaking of the composite might have been due to momentary contact of the electrode with the ceramic material. No sparking observed, shown in Figure 4.3

2. As the electrode of the EDM machine is brought down for referencing and inspite of having NC control in the Z-direction the ceramic composite breaks down. The breaking of the composite might have been due to momentary contact of the electrode with the ceramic material. No sparking observed, shown in Figure 4.4
3. As the electrode of the EDM machine is brought down and inspite of having NC control in the Z-direction and an aluminium sheet to prevent physical contact between the electrode and the ceramic composite, the ceramic composite breaks down. The breaking of the composite might have been due to momentary contact of the electrode with the ceramic material through the aluminium sheet. No sparking observed, shown in Figure 4.5

Fig.4.3 C-SiC after experiment 1

Fig.4.4 C-SiC after experiment 2
4.4.2 Observations - Experiments 2

1. During the first one hour the top layer of the sample was being machined. These settings of parameters resulted in a thread like formation between the top surface of the sample and the electrode. As a result there were frequent short circuits. This phenomenon was observed only on this setting and only for initial one hour. On these setting of parameters on the EDM, process proceeded ahead smoothly. No process abnormalities observed.

The machining on these two settings results in pitting on the top surface. The electrode shows carbon deposit on the surface. Total time for machining 5.5mm depth was five hours.

2. On the second set of input parameters the EDM process proceeded ahead smoothly. No process abnormalities observed.
The machining on these two settings results in delamination on the top surface. The electrode shows carbon deposit on the surface. Total time for machining 3.5mm depth was three hours.

Figure 4.7 shows the EDM process. The figure 4.8 shows the holes produced after drilling on C-SiC composite.

Fig.4.6 Workpiece used for trial 2

Fig.4.7 Machining in progress on EDM machine
Fig. 4.8 Holes drilled on C-SiC using EDM

Fig. 4.9 Hole drilled by EDM showing delamination
4.5 Conclusion

The enlarged view of the holes drilled by the EDM process are shown the Fig.4.9 and Fig.4.10. The figures show delamination at the entry surface of holes and predominantly large heat affected zone which deteriorates the surface quality of the hole produced. During the second experiment the current was reduced. It allowed drilling but machining was too slow. Moreover it was observed that a thin black thread like formation occurred frequently. This lead to short circuiting due to which the machine had to be stopped and restarted.