UNIVERSITI TEKNOLOGI MARA

EFFECT OF DIFFERENT DIELECTRICS AND WORK PIECE VIBRATION ON ELECTRICAL DISCHARGE MACHINING (EDM)

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ABSTRACT

Electrical Discharge Machining (EDM) is one of the non-traditional machining techniques. It has been widely used in Malaysia for machining plastic injection moulds, stamping dies and parts for automotive, defense, electronic and telecommunication industries. The process is based on removing material from a part by a series of repeated electrical discharges between a tool called electrode and the work piece with the presence of dielectric. The dielectric serves as the transportation of removed particles, remains electrically non-conducting until the breakdown voltage is reached, reconditions the dielectric strength, increases the energy density in plasma channel and cools the electrode. A survey was conducted in a few industries in Selangor area and found that Tungsten Carbide, ASSAB 718HH and SKD 61 are the commonly used materials for making moulds. Different industries are using different dielectrics for machining similar materials, which prompted this investigation to find the machining performance of the three materials using different dielectrics. The performances of machining using different dielectrics are measured through material removal rate (MRR), tool wear ratio (TWR) and surface finish (SF). Three different types of dielectrics viz., Kerosene, Novis and Amoil were employed in the experiments using copper electrode. 60 specimens were used for the study. Positive as well as negative polarities of machining were used and the parameter setting for each work piece material is as follows: Tungsten Carbide with 8A and 10A, ASSAB 718HH with 4A and 6A while SKD 61 was with 3A and 6A. The machining was conducted using Hitachi H-DS02N EDM machine and the research methodology together with the equipment used throughout the experiments are presented. An introductory study was conducted to find the effect of work piece vibration on EDM performance. The study was carried out using Sodick A30R EDM machine equipped with vibration generator and data acquisition system. The amplitude and frequency employed are 1μm and 400Hz respectively. Selected work pieces were examined using Scanning Electron Microscope (SEM) and Electron Dispersive X-Ray Spectroscopy (EDX) for the surface and elemental analysis. Using dimensional analysis, the experimental results are compared with established model and presented. Pugh's Method is employed to select the best machining combination using ranking system with independent scores. The results confirm that different types of dielectric do influence the machining performance. Overall results show that Tungsten Carbide can be machined efficiently using Kerosene under H(+) and Amoil under H(-). ASSAB 718HH is best machined with Novis under H(+) while SKD 61 is best machined with Amoil under H(+). It was found that vibrating the work pieces made of SKD 61 under H(+) enhances the MRR.

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CONTENTS

CHAPTER 1

INTRODUCTION

A manufacturing industry in general is converting raw materials to finish products by applying several production processes. In manufacturing engineering, machining operations are often considered to be the most important process [1]. Even if the machining is not directly involved in the production process, the supporting materials such as moulds, dies, jigs and fixtures, which are used in the production are made by the machining process.

Machining is the removal of material from a work piece [2] to make it as a useful product having the required dimensions. In order for a metal to function as a product, it needs to undergo several production processes. In most cases several different machining processes need to be carried out before a metal becomes a product. Machining can also be a secondary process where it is done for finishing operation such as in metal casting industry where only minor trimming is needed [3]. Basically there are two major categories of machining viz. traditional machining and non-traditional machining.

1.1 Traditional Machining

Traditional machining is the machining process in which work piece material is removed in the form of chips through direct and manual contact with a cutting tool [4]. In general, traditional machining includes the metal cutting process and grinding process. The