



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

STUDY ON EDM ELECTRODE WEAR

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Design) with Honours.

by

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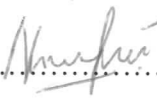
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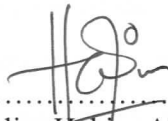
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APPROVAL

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ABSTRACT

Electrical Discharge Machining (EDM) is non-traditional manufacturing process for shaping hard metals and forming deep and complex-shaped holes by arc erosion in all kinds of electro-conductive materials. Despite that, EDM also 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. The mains problems in EDM is the high rate of tool wear. The objective of this project are to study the behavior of electrode wear, to analyze the effect of process parameter on electrode wears and propose an optimum machining condition of EDM. As a result, there are 9 experiments will be conducted with different peak current (IP) and gap size. And mathematical modeling which is Design of Experiment (DOE) program is used to analysis data for optimization result. The obtain result according to this study is the optimum machining conditions that can be implemented to reduce the rate of the tool wear and at the same time the machining productivity and process reliability are increased.

Keywords: EDM, Electrode, Electrode Wear, EDM Parameters.

ABSTRAK

Pemesinan Nyahcas Elektrik (EDM) adalah proses pembuatan moden berfungsi membentuk logam berbentuk keras, dalam dan lubang berbentuk kompleks melalui hakisan lengkungan dalam semua bentuk bahan pengaliran elektro. Di samping itu, EDM juga adalah proses mempergunakan fenomena pembuangan nyahcas elektrik dalam janakuasa elektrik, walaubagaimanapun elektrod memainkan peranan penting yang mana memberi kesan kepada kadar pembuangan bahan dan kadar kehausan mata alat. Masalah utama dalam EDM adalah kadar kehausan mata alat yang tinggi. Tujuan projek ini dibuat adalah untuk mengkaji kelakuan kehausan elektrod, menganalisis kesan proses parameter terhadap kehausan elektrod dan juga mencadangkan keadaan pemesinan yang optimum. Kesannya, terdapat 9 eksperimen akan dijalankan dengan menggunakan arus puncak dan saiz celahan yang berbeza. Dan model matematik yang mana adalah rekabentuk eksperimen digunakan untuk menganalisis data dalam mendapatkan parameter yang optimum. Hasil yang diperolehi daripada kajian ini adalah keadaan pemesinan yang optimum di mana ianya boleh diaplikasikan untuk mengurangkan kadar kehausan mata alat dan pada masa yang sama proses produktiviti dapat ditingkatkan.

Kata Kunci: EDM, Elektrod, Keausan Elektrod, EDM Parameter.

DEDICATION

For my dearest mom and dad.

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LIST OF ABBREVIATIONS

EDM	-	Electrical Discharge Machining
DC	-	Discharge Current
CNC	-	Computer Numerical Control
MRR	-	Material Removal Rate
SAE	-	Society of Automotive Engineers
IP	-	Peak Current
DOE	-	Design of Experiment

CHAPTER 1

INTRODUCTION

1.1 Project Background

Electrical discharge machining (EDM) is a non-traditional manufacturing process based on removing material from a part by means of a series of repeated electrical discharge between tool called the electrode and the part being machined in the presence of a electric fluid. At present, EDM is widespread technique used in industry for high precision machining of all types of conductive materials such as metals, metallic alloys, graphite, or even some ceramics material of any hardness (C.J. Luis *et al.*2005). In tool die and mould making industries, EDM is commonly used for machining heat treated tool steels materials.

EDM also manufacturing process based the erosion of metals sparks discharges. Shaped tool or known as electrode and the workpiece are the basics EDM system which connected to a DC power supply and place in a die electric. The sparks in this process erode away the electrode, thus changing its geometry and adversely affecting the shape produced and its dimensional accuracy. Tool (electrode) wear is thus an

important factor which is related to the melting point of the electrode of the materials involved.

EDM has a high capability of machining the accurate cavities of dies and moulds. Nevertheless, electrode wear occurs during EDM process leading to a lack of machining accuracy in the geometry of workpiece. Furthermore, electrode wear imposes high costs on manufacturers to substitute the eroded complicated electrodes by new ones for die making. In order to increase the machining efficiency, erosion of the workpiece must be maximized and that of the electrode minimized in EDM process (H. Zarepour *et al.* 2007).

This study will investigate an optimum machining condition and electrode wear of EDM. This investigation will be done through a several experiments between electrode and workpiece to identify an effect of process parameter on electrode wear. Furthermore, the behavior of electrode wear of EDM die sinking process will be studied to define an optimum machining condition for reducing an electrode wear.

1.2 Problem Statement

The electrode plays an important role which affects the material removal rate and tool wear rate. The main problem in EDM is the high rate of tool wear. Electrode wear occurs during the EDM operation when the electrode gets eroded due to the sparking action. Machining parameter is the major factors that contribute an electrode wear.

1.3 Objective

- i. To study the behavior of electrode wear.
- ii. To analyze the effect of process parameter on electrode wear.
- iii. To propose an optimum machining condition of EDM.

1.4 Scope

This project is focuses on the electrode wear and identifies an optimum machining condition of EDM. Therefore, the behavior of electrode wear will be studied and investigated. The main focus is on electrode wear of EDM. In addition, this project aims to finding the effect of process parameters on electrode wear of electrical discharge machining die sinking through the several experiment. The process parameter in this project is focused on peak current and gap size.

1.5 Schematic of Project

Chapter 1 describes about the background of the study, objective, scope of project and problem statement.

Chapter 2 instead some literature reviews related to the study which includes reviews on EDM machine, its principles and its application, overview of EDM die-sinking and it's significant and description of electrode wear.

Chapter 3 explains the methodology and the flow of this project in detail from the beginning.

Chapter 4 shows the description of experiment, the result of the analysis and the presentation of data.

Chapter 5 includes a discussion from the experiment that had been done, the results of the study and implication of the findings of the study.

Chapter 6 presents a conclusion on the study and suggestion or recommendation for the future.

1.6 Gantt Chart

Gantt chart has been generated to present the sequence of project activities. It also gives a visual presentation of the schedule of the project flow. Despite that, Gantt chart is very useful tool to monitoring the project progress. Figure 1.1 and Figure 1.2 below are the Gantt chart for PSM 1 and PSM 2. Figure 1.1 show a planning for PSM 1 which is contains an introduction, literature review and methodology while Figure 1.2 present a flow for PSM 2 that includes a result, discussion and conclusion.

Gantt Chart of PSM 1

No	Activity	Duration	Start	Finish	JULY				AUGUST				SEPTEMBER				OCTOBER					
					W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16	W17	
1	Selecting title for PSM.	1 wk	7-Jul	14-Jul	■																	
2	Discuss the objectives, scope and problem statement with supervisor.	1 wk	16-Jul	23-Jul		■																
3	Research and literature review.	9 wks	16-Jul	17-Sep		■																
4	Writing up chapter 1- Introduction.	2 wks	14-Aug	23-Aug						■												
5	Developing methodology.	2 wks	23-Aug	6-Sep								■										
6	Send draft to supervisor.	1 wk	6-Sep	13-Sep										■								
7	Refinement.	3wks	13-Sep	4-Oct											■							
8	Report submission.	1 day	8-Oct																■			
9	Presentation preparation.	3 wks	8-Oct	22-Oct															■			
10	PSM presentation.	2 day	30-Oct	31-Oct																	■	

Figure 1.1: Gantt Chart of PSM I