PERFORMANCE AND EVALUATION OF GRAPHITE WHEN MACHINING HARDENED STEEL ASSAB 718

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To My Beloved Father, Mother, Wife, Brothers,
Sisters and my Daughter

Last but not least to all the prayers, courage, and confidence and trust that you all gave to me. May Allah bless all people that I love and it is my honor to share this happiness with my loved ones.

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ABSTRACT

This project presents the machining of ASSAB718 hardened steel using sinker electro-discharge machining involving two different graphite electrodes. POCO EDM4 and POCO EDM200 The main purpose of this study was to investigate the influence of various parameters on the machining characteristics, namely, surface roughness (Ra), Material removal rate (MRR), Electrode wear rate (EWR), and Microcracks depth after undergoing sinker EDM process. The Full Factorial Design of Experiment (DOE) approach with two-levels was used to formulate the experimental plan and, to analyze the effect of each parameter on the machining characteristics four factors under study were pulse interval (A), pulse duration on (R), peak current (P) and servo voltage (SV). Confirmation tests were conducted for the optimum conditions for each machining characteristics in order to verifying and comparing. Design Expert software was utilized to analyze the above results. The, servo voltage and pulse of signal have appeared to be significant to all responses investigated. Overall, the results from the confirmation tests showed that the percentage of performance was acceptable due to all the results obtained were within the allowable value which was less than 11% of margin error for EDM200 and 7.23% for EDM4 electrodes respectively.

ABSTRAK

Projek ini mengkaji pemesinan keluli keras (ASSAB718) menggunakan pemesinan nyahcas elektrik (EDM) melibatkan dua jenis elektrod grafit. Tujuan utama kajian ini ialah untuk mengkaji pengaruh pelbagai parameter dalam EDM pembenam acuan, iaitu kekasaran permukaan (Ra), kadar pembuangan bahan (MRR), kadar kehausan elektod (EWR) dan kedalaman mikrorekahan selepas melalui proses EDM pembenam acuan. Pendekatan reka bentuk eksperimen (DOE) faktoran penuh melibatkan dua aras digunakan untuk menyediakan susun atur eksperimen, untuk menganalisis pengaruh setiap parameter ke atas ciri pemesinan dan untuk menganggarkan penetapan optimum bagi setiap parameter EDM iaitu sela denyutan (A), tempoh denyutan on, (R), arus puncak (P), dan voltan servo (SV). Ujian pengesahan juga dijalankan pada keadaan optimum bagi setiap ciri pemesinan bertujuan untuk membanding dan mengesahkan keputusan anggaran secara teori menggunakan perisian Design Expert. Dalam kajian ini, pemesinan dilakukan menggunakan mesin EDM CNC jenis Roboform 100 (4 paksi). Pengukuran Ra pula menggunakan Mitutoyo Formtracer CS-5000 dan kedalaman mikrorekahan diukur menggunakan Mikroskop Imbasan Elektron XL40. Umumnya, keputusan yang diperolehi menunjukkan yang denyutan on dan arus puncak adalah bererti terhadap kesemua sambutan yang dikaji. Secara keseluruhannya, keputusan ujian pengesahan boleh diterima kerana kesemua hasil memberikan jidar ralat kurang daripada 11%.

TABLE OF CONTENTS

CHAPTER		TITLE	PAGE
		DECLARATION	ii
		DEDICATION	iii
		ACKNOWLEDGEMENTS	iv
		ABSTRACT	v
		ABSTRAK	vi
		TABLE OF CONTENTS	vii
		LIST OF TABLES	xi
		LIST OF FIGURES	xiii
		LIST OF SYMBOLS	xv
		LIST OF APPEENDICES	xvi
1		**INTRODUCTION**	
	1.1	Introduction	1
	1.2	Background of the Project	1
	1.3	Problem Statement	2
	1.4	Objective	3
	1.5	Scope	3
	1.6	Significance of study	4
	1.7	Project Structure	4

2	**LITERATURE REVIEW**		
	2.1	Introduction	5
	2.2	EDM Die Sinking process**:**	6
	2.2.1	Limitation of EDM	9
	2.3	EDM Electrodes	9
	2.3.1	Electrodes Material	10
	2.3.2	Graphite Material	10
	2.3.3	Graphite Grades within Classifications	11
	2.4	EDM Machining Parameter	16
	2.4.1	Discharge voltage:	17
	2.5.2	Pulse (On-time) and pulse interval (Off**)**	18
	2.5.3	Polarity	19
	2.5.4	Electrode gap	20
	2.5.5	Dielectric Fluid	20
	2.5.6	Concentration of EDM	21
	2.5.7	Type of dielectric flushing	23
	2.5.8	Surface Finish	23
	2.5.9	Surface Integrity	24
	2.5.10	White Layer	25
	2.5	Machining Characteristics	30
	2.7	summary	32
3	**METHODOLOGIES**		
	3.1	Introduction	33
	3.2	Research Methods and Procedures	33
	3.1.2	Workpiece Material	36
	3.2.2	Electrode Materials	36
	3.2.3	Machining Parameters	37
	3.3 **4**	Measuring of Responses	39
	3.3.1	Volumetric relative wear	40
	3.3.2	Material Removal rate (MRR)	40
	3.3.3	Microcracks	41
	3.3.4	Surface Roughness	41

	3.4	Experimental Equipment	41
4		**RESULTS AND DATA ANALYSIS**	
	4.1	Introduction	46
	4.2	Experimental Results EDM4	46
		4.2.1 Machining Time	47
		4.2.2 Weighing Process	48
		4.2.3 Surface Roughness	49
		4.2.4 Microcracks	50
		4.2.5 ANOVA Analysis	51
		4.2.5.1 Analysis Results for Ra	52
		4.2.5.2 Analysis Results for MRR	54
		4.2.5.3 Analysis Results for EWR	56
		4.2.5.4 Analysis Results for Microcracks	58
		4.2.6 Confirmation Tests	60
		4.2.6.1 Comparison Tests for EDM4	61
		4.2.7 Comparison of Test Results for EDM4	62
	4.3	Experimental Results EDM200	64
		4.3.1 Weighing Process	64
		4.3.2 Microcracks	65
		4.3.3 ANOVA Analysis	66
		4.3.3.1 Analysis Results for Ra	67
		4.3.3.2 Analysis Results for MRR	69
		4.3.3.3 Analysis Results for EWR	71
		4.3.3.4 Analysis Results for Microcracks	73
		4.3.4 Confirmation Tests for EDM200	76
		4.3.5 Comparison of Test Results for EDM200	77
	4.4	summary	78
5		**DISCUSSIONS**	
	5.1	Introduction	78
	5.2	Surface Roughness, Ra	79

	5.3	Material Removal Rate MRR	79
	5.4	Electrode Wear Rate EWR	80
	5.5	Microcracks	80
	5.6	Summary	81
6	**CONCLUSIONS**		
	6.1	Conclusions	82
	6.2	Recommendations	84
REFERENCES			85
Appendices A-E			88-114

LIST OF TABLES

NO.	TITLE	PAGE
2.1	POCO Graphite grade EDM4	12
2.2	Graphite electrode weights	13
2.3	Classification of EDM Graphite Electrodes	14
2.4	Specification of electrodes	16
2.5	peak current and pulse duration effect to work machined surface	27
2.6	sinking EDM parameters affect the surface integrity of hardened steel	28
2.7	sinking EDM parameters affect the tool wear of hardened steel	29
3.1	Classification for the material to be used in the experiment	36
3.2	electrode properties	37
3.3	General machining parameter	38
3.4	The parameters and the value used in experiment	39
4.1	Machining Time when using EDM4, EDM200	47
4.2	Weighing of workpiece (lift) and Weight of EDM$ electrode (right)	48
4.3	MRR &EWR for Electrode EDM4	49
4.4	Surface Roughness (Ra) for Electrodes EDM4 and EDM200	50
4.5	Machining response results for Electrode EDM4	51
4.6	ANOVA for surface roughness, Ra	52

4.7	ANOVA for Material Removal Rate MRR	54
4.8	ANOVA for Electrode Wear Rate EWR%	57
4.9	ANOVA for Microcracks	59
4.10	Quality characteristics of the machining performance.	61
4.11	Confirmation test results for surface roughness, Ra)	61
4.12	Confirmation test results for Microcracks	61
4.13	Confirmation test results for Material Removal Rate MRR.	62
4.14	Confirmation test results for Electrode Wear Rate EWR %.)	62
4.15	Comparison test results for all responses. EDM 4	63
4.16	Weighing of workpiece (lift) and Weight of EDM200 electrode (right)	64
4.17	MRR &EWR for Electrode EDM4	65
4.18	Machining response results for Electrode EDM200	66
4.19	ANOVA for surface roughness, Ra	67
4.20	ANOVA for surface roughness, MRR.	70
4.21	ANOVA for Electrode Wear Rate (EWR %)	72
4.22	ANOVA for Microcracks	74
4.23	Quality characteristics of the machining performance200.	76
4.24	Confirmation test results for surface roughness, Ra.	76
4.25	Confirmation test results for microcracks	76
4.26	Confirmation test results for Material Removal Rate MRR	77
4.27	Confirmation test results for Electrode Wear Rate EWR% .	77
4.28	Comparison test results for all responses.EDM200	78
5.1	The comparison of setting parameters with previous researchers	92

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
2.1	CNC EDM Die Sinking Machine Roboform 100 (4 Axis)	6
2.2	The Process die sinking1	8
2.3	The Process die sinking2	8
2.4	The Process die sinking3	8
2.5	EDM4 specification	15
2.6	EDM200 specification	15
2.7	List of process factors for EDM	17
2.8	Actual profile of a single EDM pulse	18
2.9	jet flushing using flushing nozzles	21
2.10	Structure material layers	26
2.11	Sparking gap	31
3.1	Overall summary of Research Methodology	34
3.2	The view of work piece	36
3.3	Electrode cross-section view	37
3.4	CNC EDM Die Sinking Machine Robform 100 (4 Axes)	42
3.5	The Digital Rockwell Hardness Tester machine	42
3.6	Formtracer CS - 5000 Mitutoyo	43
3.7	High Power Optical Microscope – Zeiss Axiotech	43
3.8	Balancer device	44
3.9	MECATONE T201A	44
3.10	The sand grind and the polish machine	45
4.1	Half Normal probability plots for Ra EDM4	53
4.2	Main Interactions for Ra EDM4	53
4.3	Half Normal probability plots for MMR EDM4	55

4.4	Interaction plot for MMR EDM4	56
4.5	Half Normal probability plots for EWR%. EDM4	57
4.6	Interaction plot for EWR%. EDM4	58
4.7	Half Normal probability plots for Microcracks EDM4	59
4.8	Interaction plot for microcracks EDM4	60
4.9	Half Normal probability plots for Ra.EDM200	68
4.10	Interaction plot for Ra EDM200	69
4.11	Half Normal probability plots for MRR. EDM200	70
4.12	Interaction plot for MRR EDM200	71
4.13:	Half Normal probability plots for EWR% EDM200	72
4.14:	Interaction plot for EDM200	73
4.15	Half Normal probability plots for Microcracks EDM200	75
4.16	Interaction plot for EDM200	75

LIST OF SYMBOLS

EDM	-	Electrical Discharge Machining
WEDM	-	Wire Electrical Discharge Machining
MRR	-	Material Removal Rate
EWR	-	Electrode Wear Ratio
Ra	-	Surface Roughness
LMC	-	Length of Microcracks
SEM	-	Scanning Electron Microscopy
V	-	Machining Voltage
P	-	Peak Current
A	-	Pulse Duration (On-time)
R	-	Pulse Interval Time (Off-time)
CNC	-	Computer Numerical Control
DOE	-	Design of Experiment
ASSAB718		Hardened Steel Working Material, ASSAB Steel Grade
EDM4, 200		Electrode Grade Level
We		Weight of Electrode
Wm		Weight of Working Material

LIST OF APPENDICES

APPENGIXS	TITLE	PAGE
	References	98
A	The overall results for surface roughness EDM4	103
B	The overall results for surface roughness EDM200	109
C	The overall results for Microcracks structure EDM4	115
D	The overall results for cracks structure EDM200	122

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter discusses the basic ground of the project. It is followed by Problem statement, project objective, scopes and finally project structure.

1.2 Background of the Project

Electrical discharge machining, commonly known as EDM, is a process that is used to remove metal through the action of an electrical discharge of short duration and high current density between the tool and the work piece. There are no physical cutting forces between the tool and the workpiece involved. EDM has proved valuable especially in the machining of super-tough, electrically conductive materials such as the new space-age alloys. It can be used to produce parts with intricate shape that is impossible when using conventional cutting tools.

This machining process is continually finding further applications in the metal machining industry. It is being used extensively in the plastic industry to produce cavities of almost any shape in metal moulds. Other applications include production of critical parts for aerospace, electronics and medical industries. Although the application of EDM is limited to the machining of electrically conductive work piece materials, the process has the capability to cut these materials regardless of their hardness or toughness (Li Li, Y.S. Wong January 2001)

In recent years, EDM researchers have explored a number of ways to improve the sparking efficiency including some unique experimental concepts that depart from the EDM traditional sparking phenomenon. Despite a range of different approaches, this new research shares the same objectives of achieving more efficient metal removal coupled with a reduction in tool wear and improved surface quality .Research areas in EDM fall under three major headings. The first relates to machining performance measures such as material removal, tool wear and surface quality (SQ). The second area describes the effects of process parameters including electrical and non-electrical variables, which are required to optimize the stochastic nature of the sparking process on the performance measures. Finally, research concerning the design and manufacture of electrodes has also been reported (S.T. Newman 2003)

1.3 Problem Statement

EDM is commonly used in tool, die and mould making industries for machining heat-treated tool steel materials. The heat-treated tool steel material falls in the difficult-to-cut material group when using conventional machining process.

1) Comparing the Performance of POCO EDM4 and POCO EDM200 electrodes from material removal rate MRR, electrode wear rate EWR, achievable roughing surface finish and Microcracks.

2) To evaluate the optimal condition for each electrode. by using DOE soft wear and conformations tests

1.4 Objectives

The objectives of this research were:

1. To evaluate the performance of sinker electro-discharge machine(EDM)on hardened steel(ASSAB718)

2. To evaluate the performance of graphite electrode in term of surface roughness, material removal rate, electrode wear rate and microcracks

1.5 Scope

The scopes of this project were limited to the following

1. Workpiece material used was hardened steel ASSAB 718 with hardness up to 59 HRC

2. Electrode material was limited to two types of graphite materials.

3. Variable machining parameters were limited to current, voltage, pulse off/on and pulse width while other parameters were fixed.

4. Chermill Robofirm 100 Electrical discharge machine EDM die sinking were used. for conducting experimental.

1.6 Significance of study

The current study focused on the evaluation of the performance of graphite electrodes when machining hardened steel material. It was hoped that the findings could be used by industrial practitioners to select the most suitable cutting parameters for hardened steel and realizing its economic potential to the fullest.

Generally, the significance of study can be summarized by the following points:

1. Better understanding of graphite electrode behaviors when machining hardened steel at various conditions.

2. Information gathered from the study becomes useful especially for die and mould making industries to consider graphite as a candidate for replacing copper electrode particularly for varying works

1.7 Project Structure

This project were include about six chapters with references and appendixes were all illustrated in the contents

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