

**SURFACE MODIFICATION USING EDM WIRE
CUT METHOD-
A FEASIBILITY STUDY**

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**B. ENG. (HONS.) MANUFACTURING
ENGINEERING
UNIVERSITY MALAYSIA PAHANG**

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Report submitted in partial fulfillment of the requirements
for the award of the degree of
Bachelor of Engineering in Manufacturing Engineering

Faculty of Manufacturing Engineering

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Bachelor of Engineering in Manufacturing.

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I hereby declare that the work in this thesis is my own except for quotation and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

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LIST OF ABBREVIATIONS

Al	Aluminum
E_D	Energy released due to one spark (Watt)
E_S	Specific energy (kJ/s)
I	Pulse current (Ampere)
V	Gap voltage (Volt)
T_{on}	on-time (μ s)

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ABSTRACT

Wire electrical discharge machining wire EDM removes electrical conductive materials by the electrical sparks. This research is focused on the surface integrity and the process parameters of the selected materials eg. steel and A-alloy. It is expected that grain refinement occurred due to rapid solidification of molten metal on the surface. So, hardness of material can be increase. Recast layer formed on the metal surface by wire EDM is expected to be harder than the subsurface, due to the rapid-cooling of the molten metal. Present work attempts to identify the effect of various EDM parameters on the layer formation. A preliminary metallurgical investigation of EDM machined surface was conducted to determine the effect of process parameters like wire speed and spindle feed rate to morphology and microstructure change of work piece.

ABSTRAK

Wire pelepasan elektrik pemesinan dawai EDM mengeluarkan bahan konduktif elektrik oleh bunga api elektrik. Kajian ini memberi tumpuan kepada integriti permukaan mengenai mengenai parameter proses dan pemilihan material. Ia dijangka bahawa bijian berlaku disebabkan pemejalan pesat logam lebur di permukaan. Jadi, kekerasan bahan boleh meningkat. lapisan Susunan Semula terbentuk pada permukaan logam oleh dawai EDM dijangka menjadi lebih sukar daripada sub-permukaan, kerana cepat-penyejukan logam lebur. Kajian yang bertujuan untuk mengenal pasti kesan pelbagai parameter EDM pada pembentukan lapisan. Satu siasatan logam awal EDM permukaan dimesin telah dijalankan untuk menentukan kesan parameter proses seperti kelajuan wayar dan kadar suapan spindle morfologi dan mikrostruktur perubahan benda kerja.

CHAPTER 1

INTRODUCTION

1.0 BACKGROUND OF RESEARCH

Nowadays, advance machining plays an important role in the manufacturing sector. Wire cut electrical discharge machining is one type of the advance machining that able to machine high hardness of electrical conductive material. The main advantage of this type of machining is it able to produce intricate two dimensional and three dimensional shapes on workpiece. Wire electrical discharge machining (WEDM) removes electrical conductive materials by the electric sparks. Dielectric fluid cool and flush away the erodes particles. A good surface integrity of material will always contribute to prominent physical and mechanical properties.

Surface metallurgical transformation is concerned with the surface layer's nature that undergoes the microstructural changes. Phase transformation is further study in molten and recast layer form after wire EDM.

This research focuses on the surface integrity regarding about the process parameters and selection of material. In this study, die steel and aluminum blocks will be machined and compared to the surface integrity like micro hardness, grain size and micro structure change.

2.0 PROBLEM STATEMENT

Recast layer form on material surface by wire EDM is brittle due to the chromium and carbide dispersion. Chromium accelerates the grain growth rate and show brittle properties. It will become a problem in the application. Different materials are used for wire EDM and identify the effects by metallurgical investigation of machined surface integrity.

Process parameters of wire EDM like voltage, current pulse duration and wire feed relate to the morphology and microstructure change of work piece. Different process parameters will generate different thickness of recast layer. Thus, metallurgical investigation on die steel and aluminum after wire EDM is necessary.

3.0 SIGNIFICANT OF STUDY

Present work is the first of its kind to investigate the effect of EDM wire cut method on the surface modification of 0.25% carbon composition of low carbon die steel and aluminum A6061 alloy.

4.0 OBJECTIVES

The main objective of this project is:

- a) To investigate the effect of EDM wire cut parameters on the microstructure of aluminum alloy and die steel.
- b) To study mechanical properties like micro-hardness of machined surface.
- c) To able to optimize the process parameters like wire speed and spindle feed to get good surface integrity.

5.0 PROJECT SCOPE

This research is focus on metallurgy change of die steel and aluminum surface after wire cut EDM. Linear motor driven by Sodick VZ300L model carries out wire cutting on the specimen. Spark emission spectrometer couple with Field Emmision Scanning Electron Microscope (SEM) to examine the elemental composition and microstructure investigation of material. Surface roughness is evaluated by the surface roughness tester. Vickers hardness tester measures the micro hardness of workpiece. The wire cut machining is carried out in the advance machining laboratory, whereas specimen testing conducted in material lab in faculty of manufacturing.

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