THE CORRELATION BETWEEN MACHINIBILITY AND SURFACE ROUGHNESS IN CNC LATHE MACHINING

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DECLARATION

I declare that this project report entitled "The Correlation between Machinability and Surface Roughness in CNC Lathe Machining" is the result of my own research except as cited in the references.

Signature :……

Name : …….

Date :……..

APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in term of scope and quality for the award of the Degree of Bachelor of Mechanical Engineering with Honours.

Signature :……

Supervisor's Name : …….

Date :……..

DEDICATION

First and Foremost praise is to,

Allah S.W.T, the Almighty, the greatest of all, on whom ultimately we depend on sustenance and guidance.

To my beloved mother and father,

SALAMSIAH BINTI MOHTAR

AMRAN BIN ZAKARIA

For all ears and shoulders

ABSTRACT

Surface finish is the predominant characteristic for machined component to evaluate their quality. Surface finish gives great effect on the performance or functioning of mechanical parts and production costs. The present studies investigate about the surface quality in turning operation of Aluminum Alloy 6061 and Mild Steel AISI 1060 on CNC OKUMA LB-R Lathe machine. Three parameters namely spindle speed, feed rate, and depth of cut are varied to study their effects of machining parameters on the surface finish of the machined materials. Two machining condition was conducted which are machining under dry and coolant condition to determine the optimal surface roughness on the surface finish of Aluminum Alloy 6061 and Mild Steel 1060. An experiment on 1 inch diameter and 150mm long of both 32 Aluminum Alloy 6061 and Mild Steel AISI 1060 have been carried out. Surface Roughness of the machined materials was measured by using 3D Non-Contact Profilometer. Results showed that quality of materials depends on the certain value of cutting speed, feed rate and depth of cut. Besides, optimal surface roughness effective machining under coolant condition.

ABSTRAK

Kemasan permukaan adalah ciri utama bagi komponen permesinan untuk menilai kualiti mereka. Kemasan permukaan memberi kesan yang besar terhadap prestasi atau fungsi bahagian mekanikal dan kos pengeluaran. Kajian sekarang menyiasat tentang kualiti permukaan dalam beralih operasi aluminium 6061 dan keluli ringan AISI 1060 pada mesin pelarik CNC. Tiga parameter iaitu kelajuan gelendong, kadar suapan, dan kedalaman pemotongan berbeza-beza untuk mengkaji kesan parameter pemesinan pada permukaan permukaan bahan-bahan pemesinan. Dua keadaan pemesinan telah dilakukan di mana pemesinan di bawah keadaan kering dan sejuk untuk menentukan kekasaran permukaan optimum pada penamat permukaan aluminium 6061 dan keluli ringan 1060. Eksperimen pada diameter 1 inci dan panjang 150mm kedua-dua 32 aluminium 6061 dan keluli ringan AISI 1060 telah dijalankan. Permukaan Permukaan bahan-bahan pemesinan diukur dengan menggunakan Profilometer Non-Contact 3D. Keputusan menunjukkan bahawa kualiti bahan bergantung kepada nilai tertentu laju pemotongan, kadar suapan dan kedalaman potong. Selain itu, kekasaran permukaan yang optimum diperolehi pemesinan di bawah keadaan penyejuk.

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LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Al 6061	-	Aluminum Alloy 6061
CNC	-	Computerized Numerical Control
DOC	-	Depth of cut
RPM	-	Revolution per minutes
SOP	-	Standard operation procedure

LIST OF SYMBOLS

V	-	Cutting Speed
f	-	Feed rate
D	-	Initial diameter
d	-	Final diameter
D_{cut}	-	Depth of cut
π	-	Circular Constant
μ	-	Micro
m	-	Meter
mm	-	Millimeter
N	-	Spindle Speed

CHAPTER 1

INTRODUCTION

1.1 Research Background

Nowadays, machining industries are contributing a lot in metal based industry. Machining is any of various processes in which a cutting tool is used to remove or cut an unwanted raw material into a desired shape and size by a controlled removal process. Usually, machining process used to manufacture metal product but it also can be used on materials such as wood, plastic, ceramic and composites. In most machining process, there are two relative motion which are divided into primary and secondary motion. For primary motion it is called cutting speed and feed rate for secondary motion. These two relative motion combined will produced the desired shape.

Next, surface finish or surface roughness is the predominant characteristic for machined component to evaluate their quality. Surface finish gives great effect on the performance or functioning of mechanical parts and production costs. For example in machine tool industries such as chains, screws, rivets, nails and etc. The surface finish is important in term of tolerances as it can reduces assembly time thus reduces operation time and leads to overall cost reduction. The quality of product very much depends on surface finish. As decreasing the surface finish, also leads to decreasing the product quality. There are various parameters such as cutting speed, feed rate and depth of cut that effect the surface roughness of the machined parts.

In the traditional production industry, most machining are using conventional machine such as conventional lathe and conventional milling machine which are these conventional machine need to operate manually. During the turning operation of the conventional lathe machine, heat is produced in the cutting zone due to the friction between tool-chips and tool-work interfaces. The generated heat strongly affected the tool life and surface finish of the product especially during dry machining or machining the material

without any fluids at all, and only atmospheric air surrounding the cutting zone. In order to minimizing the temperature or generated heat at the machining zone, coolant need to apply to reduce the friction force between the tool-chips and tool-work and also it can carry away the heat produced from the cutting zone.

The principle of numerical control, as demonstrated in 1952, is the electronic version which is coded information in to machine tool instruction. For example, machining is carried out by Computer Numerical Control (CNC), in which computers are used to translate into the movement and operation of the milling, lathe and other various cutting machines. Early CNC machine reads information from tapes or punched cards. In the present day, the CNC machine tool has much advanced further functionality. CNC machines provide flexibility in selecting accurate cutting speed, depth of cut and feed rate simultaneously. This is due to the surface finish quality issue in most machined part. Surface finish becomes main indicator for the machined component quality in manufacturing.

1.2 Problem Statement

Quality plays significant role in today's manufacturing metal based industry. The demand for high quality of machined parts, focuses on surface condition of product especially on surface roughness because its effect on the product appearance, function and reliability. Surface roughness has a great influence on product quality which means the quality of product very much depends on surface roughness. The decreasing of the surface roughness quality also leads to the decreasing of product quality. However, machining industries are facing very great challenges to achieve high quality product with low cost in short time.

There are various parameters that can affect surface roughness of the machined parts which are machining parameters, geometry of the tool, material used or work piece, rigidity of machine and usage of coolant. Meanwhile, due to the surface quality issue, it will affect the mechanical properties of the machined components such as corrosion resistance and fatigue strength, wear resistance, load bearing capacity, heat transmission and load bearing capacity. Therefore, it is necessary to obtain high quality of machined surface roughness and appropriate processes parameters have to be selected to reach the desired surface quality of machined parts.

Therefore, the purpose of the study is to investigate the relationship between cutting parameters and surface roughness of the machined components. An experiment carried out

on a Computer Numerical Controlled (CNC) turning machine with different cutting parameters such as cutting speed, depth of cut, feed rate. Next, the concept of dry machining or there is no applied of coolant during the turning process economic in terms of bring down the manufacturing cost but can cause the tool wear problem, dimensional accuracy of product and low surface finish which is not good in long term effect. Hence, the implementation of coolant is the suggested ways to achieve high quality machined product and increase the tool life.

The study was carried out to evaluate the effect of parameters on the surface roughness for internal cutting profile with turning operation, where the surface roughness values were statistically comparable and to find out the optimum cutting condition by analyzing the different cutting tool length to get the lowest surface roughness in turning an Aluminum solid rod.

1.3 Objective of the Study

The objectives for this project are:

1. To study the effect of machining parameters on the surface finish of Aluminum Alloy 6061 and Mild Steel 1060 solid rod in turning operation.
2. To determine the optimum surface roughness of Aluminum Alloy 6061 and Mild Steel 1060 rod with or without coolant in turning operation.

1.4 Scope of the Study

In order to achieve the objective, the scopes are prepared as shown below:

1. Studying the surface finish of Aluminum Alloy 6061 and Mild Steel 1060 solid rod by performing Turning operation in CNC Lathe Machine with different machining parameters.
2. Determining the optimum surface quality of Aluminum Alloy 6061 and Mild Steel AISI 1060 solid rod by using coolant or without coolant during turning process at CNC Lathe Machine.
3. Analyzing the optimum surface roughness of Aluminum Alloy 6061 and Mild Steel AISI 1060 solid rod by using 3D-Non Contact Profile

1.5 General Methodology

The actions that need to be carried out to achieve the objectives in this project are listed below.

1. Literature review

   Journals, articles or any materials regarding the project will be reviewed.
2. Experimental

   An experiment will be conducted by using CNC Lathe machine according to the required data.
3. Analysis

   Data acquisition or an analysis will be presented on how the parameters and coolant affected the surface roughness on the material.
4. Report writing

   A report on this study will be written at the end of the project.