Faculty of Mechanical and Manufacturing Engineering Technology

THE STUDY OF SURFACE ROUGHNESS FOR AISI 1018 USING BORON STEEL CUTTING TOOL TEXTURE IN WET TURNING PROCESS

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Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours

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DECLARATION

I hereby, declared this report entitled "The Study of Surface Roughness for AISI 1018 Using Boron Steel Cutting Tool Texture in Wet Turning Process" is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering Technology (Process & Technology) with Honours. The member of the supervisory is as follow:

……..

(Project Supervisor)

ABSTRAK

Kajian ini telah dijalankan untuk mengkaji Kekasaran Permukaan untuk AISI 1018 dengan menggunakan alat pemotong Keluli Boron tesktur dalam proses larik kering. Projek ini memberi tumpuan kepada kekasaran permukaan AISI 1018 Keluli Karbon Rendah dengan menggunakan Kawalan Numerik Komputer (CNC) mesin larik dengan kemunculan penyejuk. Tujuan projek ini adalah untuk mendapat alat pemotong Boron corak tekstur terbaik dalam menghasilkan kekasaran permukaan yang baik. Aritmetik Purata Kekasaran Permukaan (R_a) dipilih untuk diukur sebagai parameter kekasaran permukaan. Kekasaran permukaan akan diuji dengan menggunakan Instrumen Pengukuran Kekasaran Permukaan Mitutoyo SJ-410. Kelajuan pengumpar yang dipilih untuk proses larik ialah 0.08 mm/rev. Seterusnya, parameter kadar suapan ialah 550 rpm. Akhir sekali, kedalam pemotongan ialah 0.5 mm. Proses pemesinan ini akan dilakukan pada CNC mesin larik. Corak tekstur alat pemotong Boron diukir dengan menggunakan CNC Laser mesin. Corak tekstur yang dipilih ialah berombak, serenjang, selari, luas, bujur dan baru. Parameter yang digunakan dalam pemotongan laser adalah berdasarkan buku panduan mesin pengilang dan ujian yang digunakan untuk proses ukiran.

ABSTRAK

This research was carried out to study the Surface Roughness for AISI 1018 using Boron Steel Cutting tool texture in wet turning process. This project is focuses on the surface roughness of AISI 1018 Low Carbon Steel by using Computer Numerical Control (CNC) Turning machine with appearance of coolant. The aim of this project is to find the best texture pattern of Boron Steel cutting tool in producing good surface roughness. Arithmetic Mean Surface Roughness (R_a) is selected to be measured for surface roughness parameter. The surface roughness will be test by using Surface Roughness Measuring Instrument Mitutoyo SJ-410. The selected spindle speed for turning process is 550 rpm. Next, the feed rate parameter is 0.08 mm/rev. Lastly, the depth of cut is 0.5 mm. This process machining will be performed on the CNC Turning machine. The texture pattern of Boron Steel cutting tool is engraving by using CNC Laser Machine. The selected texture pattern is wavy, perpendicular, parallel, areal, eclipse, and new. The parameter used in laser cutting is based on manual machine manufacturer and testing for engraving process.

DEDICATION

A special appreciation, I dedicate this thesis to my mother Ruzkiah Binti Mohamad Nor, my father Ariff Bin Hasan.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

AISI	-	American Iron and Steel Institute
BUE	-	Build Up Edge
CNC	-	Computer Numerical Control
CO_2	-	Carbon Dioxide
CAD	-	Computer Aided Design
CAM	-	Computer Aided Manufacturing
C	-	Carbon
Fe	-	Iron
He	-	Helium
ISO	-	International Organization for Standardization
MIT	-	Massachusetts Institute of Technology
MWF	-	Metal Working Fluid
Mn	-	Manganese
N	-	Nitrogen
NC	-	Numerical Control
P	-	Phosphorus
Ra	-	Arithmetic Mean Surface Roughness
Rq	-	Root mean square
Rp	-	Maximum profile peak height
Rt	-	Total height of the roughness profile
Rz	-	Maximum height of the roughness profile
Rv	-	Maximum profile valley depth
Rc	-	Mean height of profile element
S	-	Sulphur
US	-	United State
B	-	Boron
Mn	-	Manganese
CO_2	-	Carbon Dioxide

HRC	-	Rockwell C Hardness
HRB	-	Rockwell B Hardness

CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter will discuss about the flow of the project consists of project background, problem statement, objectives and project scope. The sub-topic has related each other to ease the readers to understand the project flow better. This project will describe about the study of surface roughness for AISI 1018 using Boron cutting tool texture in wet turning process. There are several tests to be conduct by using different Boron cutting tool texture in order to be used on turning process in CNC Turning Machine for surface roughness analysis.

1.1 Project Background

In modern manufacturing technology, Boron Steel has widely used for automotive manufacturing process. Low Boron (B) addition to the composition provide high hardenability, improve mechanical properties and weight saving up to 50% compared to others steel [1]. Also, addition of Manganese to steel provide the steel resistance to corrosion and enhance the strength to face high impact. They are good in hardness and excellence in strength. In producing good strength of boron steel, this steel undergoes hot stamping process. Hot stamping process is the process where the material is heated up at high temperature and quenching the steel in the die to form shape. This process is applied in order to improve the hardenability and reduce the mass of the material. In this project, Boron steel will be used to fabricate the cutting tool.

Boron steel that will been used in this experiment is taken from Proton Iriz car chassis that has been through hot stamping process. This Boron Steel is used to fabricate pattern cutting tool in this experiment by using Computer Numerical Control (CNC) Laser Machine. Also, Boron Steel that has been used in this experiment is from waste of car chassis. In manufacturing, defect will occur to product to one or few products, not all product in a line. Defect occur during manufacturing phase of product when overlook in production is happen and the product diverge from its intended design. Also, every product that manufacture has their own life cycle, so do car. Car life cycle is begin and ends in a factory. In life cycle, more material can recycle better the product design. In this case, Boron steel that has end of life cycle can be reused to produce the cutting tool insert. Hence, the cycle life of car chassis is improved.

In this project, texture pattern on the Boron Steel will be operate by using Computer Numerical Control (CNC) Laser Machine. Texture on the surface which call as an engraving is a process to remove a small amount on surface which is subset of laser marking. This process can cause line or texture on Boron Steel material. The texture on the material will have ability to improving cutting performance, frictional behaviour and more. The cutting parameter used in laser machining could impact the quality of the texture on cutting tool. Hence, the selected parameters for laser cutting process of this project is based on manual machine manufacturer. This cutting tool is used in turning process of AISI 1018 to find the best surface roughness of material tested. Study of surface roughness using Boron Steel texture cutting tool is a focus in this project.

Surface roughness on material is very important to have good product. Industry always seeking to find ways to have good surface roughness. Normally, cutting parameter used in machining process is affect the surface roughness. Besides that, cutting tool used

also one of the factors that affect the surface roughness of product. Surface roughness parameter that will be focused in this project is Arithmetic Mean Surface Roughness (R_a). This is due to the most effective way to measure the surface roughness. The surface roughness on the surface of material after turning process is measure by using Surface Roughness Measuring Instrument Mitutoyo SJ-410. Minitab software is used to analyse and arrange the data of the experiment.

There are 6 different type of texture on cutting tool of Boron Steel to be used for laser cutting in engraving the texture. The selection of the texture on the surface is based from research in literature review and the criteria of the texture that will be focused is texture pattern. There is some characteristic to be considered during the selection of the texture pattern on cutting tool surface such as the ability of the laser machine to cut the texture pattern. After that, there are 18 materials of AISI 1018 Low Carbon Steel will be tested on CNC Turning Machine to study the surface roughness. This material selected because it easily to be machine, approach a good balance roughness and almost used in industry.

Conventional and non-conventional is the type of the machining. In this case, non-conventional machining will be used which is CNC Laser Machine and CNC Lathe Machine. The machine is driven and operate with the help of operator in conventional machining. This machining method requires direct or driven physical contact of tool and work piece. On the other hand, non-conventional machining involve machine which are fully automated with no need of human resources to control to the function of machine. The machine is controlled by a pre-programmed computer or a robot [2]. Normally, CNC machining is more prefer in the industry because of its advantages over conventional

machining. For example, non-conventional machining offers high accuracy and surface finish better than the conventional.

The advanced software allows CNC machines to make product that cannot be made by hand even by the most skilled machinist available. The machine makes it easier for students with the help of technician to operate since it does not to have skilled work and advance machining. Once the machine is programmed, only one person requires supervising because the machine can work itself. It will reduce workload as well as the human error incident.

Furthermore, in turning operation, cutting fluid is applied during the process. Cutting fluid is important for most material in material removal process and machining operation which include turning, milling and drilling. In machining steel for high speed steel tool and coolant is used for example water, 40 percent increase in cutting speed for past machining process [3]. Thus, the cutting process does involve of cutting fluid.

1.2 Problem Statement

Nowadays, the industry facing a problem in obtain good surface roughness of the material. Surface roughness perform an important role in many areas in showing the quality of the material. Coating, friction, and heat transmission is affected with surface roughness of the material. Moreover, cutting tool used in process is a one factor that effect the surface roughness quality. The texture cutting tool for turning process is widely used in machining process since the ability to increase the quality of surface roughness is known. Surface Roughness Average (R_a) is slowly decrease with using texture tool for example pattern of wavy, perpendicular and parallel compare to tool no texture [4]. Hence, the variety of texture cutting tool is fabricated to study the performance in surface roughness for turning process. Also, in a competitive market, product price becomes increasingly important. Production cost of product is decreasing hence the product price will be decrease. The production cost of manufacture the product is one of important things that company take seriously. Lower cost of manufacturing is goals for all the company. Waste of material is one of the things that company want to avoid. Thus, waste of car chassis is used to fabricate the cutting tool to reduce the waste of material and reduce production cost. Besides that, the usage of cutting fluids also has been considered. Turning process with appearance of cutting fluid will increase the performance of machining and give good surface roughness [5]. Thus, the cutting fluid is applied during the turning process.

1.3 Objectives

The objectives for this project are:

1. To study the surface roughness of AISI 1018 Low Carbon Steel by using Computer Numerical Control (CNC) Turning Machine in wet cutting process.
2. To investigate the best texture pattern significant to surface roughness.

1.4 Project Scope

In this project, there are several scopes to be considered in order to achieve the objective such as:

i. 6 different texture patterns will be choosing to be engrave with Computer Numerical Control (CNC) Laser Machine.

ii. 18 materials to be machine with Computer Numerical Control (CNC) turning machine is AISI 1018 Low Carbon Steel with dimension of length and diameter is 100mm x 22mm by using Boron steel texture cutting tool after finish engrave process.

iii. Cutting fluid is applied during the turning process.

iv. Surface roughness testing will be conduct by using Surface Roughness Measuring Instrument Mitutoyo SJ-410.

v. Study of the surface roughness result will be conducted to investigate the best texture pattern.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

Literature review is an important aspect which is to review fundamental ideas from the research and need to be focused in the thesis. It is necessary to study on journal that relate to the project because to complete this project the knowledge is needed. This chapter consist of laser, laser machine, texture tool, turning process, machine for turning process, Boron steel cutting tool for turning process and AISI 1018 Low Carbon Steel.

2.1 Laser

Laser light is exceeding from the sun in term of brightness where it able to travel over great distance or can be focused to a very small spot. Because of that, laser is widely used in many sectors for example communication, biomedical, instrumentation, manufacturing, material processing and more Laser application was suggested and gave the theoretical basis by Albert Einstein in 1917, when he forecast the chance of stimulate emission. Laser is a word stand for Light Amplification by the Stimulate Emission of Radiation [20]. In 1960, T.H Maiman found ways to use laser application in devices and built first laser device after principle of masers to light is expand by C.H Townes and A.