UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Faculty of Mechanical and Manufacturing Engineering Technology

THE STUDY OF FLANK WEAR USING COATED LATUMA (ALTiN) BORON STEEL (22MNB5) ON ALUMINIUM (AA6061)

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

2019

THE STUDY OF FLANK WEAR USING COATED LATUMA (ALTiN) BORON STEEL (22MNB5) ON ALUMINIUM (AA6061)

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A thesis submitted

in fulfilment of the requirements for the degree of Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours

Faculty of Mechanical and Manufacturing Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2019

DECLARATION

I declare that this thesis entitled "The Study of Flank Wear Using Coated Latuma (AlTiN) Boron Steel (22MnB5) On Aluminium AA6061" is the results of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :……...

Name Siti Fikriah Binti Ahmad

:……...

Date 11th December 2019

:……...

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Bachelor of Manufacturing Engineering Technology (Process and Technology) with Honours

Signature :…….....

Supervisor Name :…… .....

Date :……

DEDICATION

To my beloved father Ahmad Bin Yaacob, my beautiful mother Zuriah binti Bidi, my siblings for giving me moral support, money, cooperation, encouragement and also understandings and to my man Muhammad Irzani thank you so much for being with me through thick and thin.

ABSTRACT

This research was carried out to study the flank wear of Boron steels coated with Aluminium Titanium Nitride (AlTiN) that used to cut the AA6061 Aluminium steel workpiece with using Computer Numeric Control (CNC) Turning Machine. The aim of this project is focus more about strength of Boron cutting tool whether it is suitable for application of cutting tool. The Boron material that used for making the cutting tool is from car chassis. Basically, Boron steel is commonly used in automotive industry which is required for the parts that need high of strength such as for car chassis. It is because the characteristic of the Boron steel itself which is strong and suitable for make as car chassis. In this project, the Boron steel from car chassis is recycle for making something useful such as cutting tool. Besides, the concept of sustainability is applied in this project. During this project, there are three parameter that will consider which are spindle speed, feed rate and depth of cut. The spindle speed is set at 100m/min, 200m/min, 300m/min. therefore, for the feed rate is set at 0.10 mm/rev and depth of cut is 0.5mm.

ABSTRAK

Kajian ini dijalankan untuk mengkaji pakai keluli bor Boron yang disalut dengan Aluminium Titanium Nitride (AlTiN) yang digunakan untuk memotong bahan kerja keluli Aluminium AA6061 dengan menggunakan Mesin Menukar Kawalan Numerik Komputer (CNC). Matlamat projek ini lebih menumpukan kepada kekuatan alat pemotong Boron sama ada ia sesuai untuk aplikasi alat pemotong. Bahan Boron yang digunakan untuk membuat alat pemotong adalah dari casis kereta. Pada dasarnya, keluli Boron biasanya digunakan dalam industri automotif yang diperlukan untuk bahagian-bahagian yang memerlukan kekuatan tinggi seperti untuk casis kereta. Ia adalah kerana ciri keluli Boron itu sendiri yang kuat dan sesuai digunakan sebagai casis kereta. Dalam projek ini, keluli Boron dari casis kereta dikitar semula untuk membuat sesuatu yang berguna seperti alat pemotong. Selain itu, konsep kelestarian digunakan dalam projek ini. Semasa projek ini, terdapat tiga parameter yang akan dipertimbangkan iaitu kelajuan gelendong, kadar suapan dan kedalaman pemotongan. Kelajuan gelendong ditetapkan pada 100m / min, 200m / min, 300m / min. oleh itu, untuk kadar suapan ditetapkan pada 0.10 mm / rev dan kedalaman potongan 0.5mm..

ACKNOWLEDGEMENTS

First of all, I would like to thanks to Allah S.W.T, the Most Merciful in complete my thesis successfully. And very special thanks to my supervisor, Ts Mohd Hairizal Bin Osman for giving me a guidance in completing my thesis with title of The Study of Flank Wear Using Coated Latuma (AlTiN) Boron Steel (22MnB5) on Aluminium AA6061.

I sincerely would like to thanks to my family that support me from I was in primary school until I further my study in University Teknikal Malaysia Melaka (UTeM). Big thanks to UTeM for giving me opportunity to gain knowledge in UTeM. I also would like to thanks to myself for struggle to complete this thesis. Last but not least, I would like to thanks to my man Muhammad Irzani for giving me moral support. Unforgotten to those is directly or indirectly contributed to complete this thesis.

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LIST OF SYMBOLS

CNC	-	Computer Numerical Comtrol
TiAlN	-	Titanium Aluminium Nitride
AlCrN	-	Aluminium Chromium Nitride
TiN	-	Titanium Nitride
B	-	Boron
Be	-	Beryllium
Cr	-	Chromium
mm	-	millimeter
hv	-	High Voltage
wt	-	weight
C	-	Celsius
L	-	Length
%	-	percentage
SEM	-	Scanning Electron Microscope
XRD	-	X-ray Diffraction
CoF	-	Coefficient of Friction

CHAPTER 1

INTRODUCTION

1.0 Introduction

For this project consists of a round insert overview that the round insert offers the strongest cutting edge. It also provides the best surface finish due to the large radius. However there are a few disadvantages. For example, the chips developed are relatively wide and difficult to break due to the long cutting edge. The load on the insert also increases due to the large contact area and the long cutting edge length. This can result in vibrations when making small or thin walled objects. Round inserts are best suited for machining that requires high cutting edge strength, such as interrupted cutting, removing scale, and not elongating cast iron when machining as chips.

1.1 Background

This project focuses on creating and producing the round insert with using boron steel for cutting tools using a CNC lathe cutting machine to cut the material. However, the previous round insert usually used carbide as insert material because of the advantages when machining hard steels. The profile provides a stronger tool without being susceptible to sharp corners. Other than that, carbides inserts with an aluminium oxide coating can also counter high temperatures generated by hard steels.

Boron is a small interstitial element added to fully killed and deoxidized steel to enhance toughness. Boron-treated steels are produced in the range of 0.0005 – 0.005%

added boron and are most effective in lower carbon steels < 0.40% C. Boron increases the strength of heat-treated steels in the quenched and tempered condition. Boron steel grades can be worked hot with cooled tooling by pressing, bending and forging. A metal lathe or metalworking is a large class of lathes designed for the precise machining of materials related to hardness. However, with the advent of plastics and other materials and their inherent versatility, they were originally created to machine metals. They are used in a wide range of applications and materials.

In machining, where the larger context is already understood, they is usually simply referred to as lathes or by more specific subtype names such as lathe tool room, turret lathe and others. These rigid machine tools eliminate material from a rotating work piece by shifting different cutting tools such as tool bits and drill bits. As for this project, the cutting tool will be used with insert that coated with Alnova, Alcrona, Latuma and the last one is uncoated. As for the material, AA6061 Aluminium alloy is used. The material has excellent weldability and produces a uniform and it is considered as the best steel for carburized parts. AA6061 Aluminium Alloy offers a good balance of toughness, strength and ductility. Then, it also provided with higher mechanical properties and improved machining characteristics. In addition, this material is widely used for cutting, bending, crimping, special bolt and much more in the manufacturing industries.

In order to obtain the optimization parameter, this project will result in an optimization procedure for cutting parameters such as feed rate, spindle speed depth cutting in laser cutting process for AA6061 Aluminium alloy.

1.2 Problem Statement

Despite the selection of insert, there are some difficult to select the material and the shape of insert which is not leave a large of wear of the insert after machining process. The wear on the insert will give a low performance and leave bad result on the material tested during machining process. Thus, the selection of material and shape of insert for machining process is very important criteria that need to be consider getting a good quality of the product. Furthermore, coating the insert will decrease wear on the insert. So that, the selection of coating also important criteria for this project. One of the ways to solve the problem is using a correct material and shape of insert then the best coating to enhance the performance of the insert. Therefore, it can improve the quality surface roughness of the product.

1.2 Objective

From the background and the problem statement that have been stated, the objectives of this project are:

1. To design and produce new insert with high properties for lathe machine.
2. To analyse the comparison of tribology of different coated cutting tool.
3. To study the flank wear of insert cutting tool.

1.3 Scope

To ensure that all project objectives are achieved, the following are few important elements that must be followed. This project involved the analysis and machining. This project is conducted using lathe machine and laser cut machine that available in laboratory of manufacturing technology. Based on research of the journal, the material selected for the insert is boron steel. For machining process, the insert is cut with using laser cut machine. Then, the insert will be coated with suitable coating that has been choosing after make some research about the coating from a few of journal. Then, use the lathe machine to test cut.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter will discuss about the article that have been chosen which related to the title of the project.

2.1 Insert

The choice of tool inserts depends on the trade between strength and flexibility. Square larger purpose angles measure stronger such as contouring round inserts and roughing and finishing square inserts. The square small angles (35° and 55°) are the most versatile measurement for complicated work. Turning inserts to their operating form are also formed or grounded. The formed square varieties measure additional cost-effectiveness and have wide application. Ground inserts the required square measure for maximum accuracy and provides well-described or sharp contours. After introducing the edge of the cutting tool into a rotating work piece, several angle square measurements are required. These angles include angle of inclination, angle of rake, angle of clearance or angle of relief, angle of approach, and radius of gear nose. As a sharp edge is weak and fractures easily, the cutting edge of an insert is prepared to reinforce it with specific shapes. These forms include a sharp radius, a chamfer, a land, or a mixture of the three. (Chandrashekar BH#, 2014)

Figure 2.1: Round insert

2.2 Material

2.2.1 Boron

Boron is associate opening component and incorporates a terribly low solubility in α-solid resolution (<0.003%). Increasing their hardness is the main function of boron additions to heat treatable steels. In relation to the benefits of sustainability and metal preservation, boron steels give important advantages of greater additional capacity and machinability relative to comparable hardness boron-free steels. Moreover, steels containing boron are also less susceptible to quench cracking and distortion during heat treatment. Subsequently, carbon-containing boron and alloy steels are commonly used in automotive, construction and other application. Some researchers indicated a tiny positive impact of boron on toughness after tempering to elevated hardness concentrations and a mildly negative impact at reduced hardness. (Saeed N. Ghali H. S.-F., 2012)

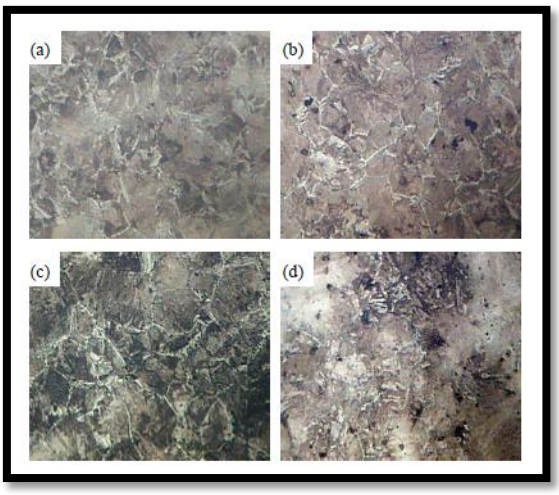

Figure 2.2: Microstructure of tempered steel

2.2.2 Properties of Boron

The 22MnB5 steel boron / manganese can be considered as the widely used material for detail creation, which must withstand high load and impact. The difficulty and high labor intensity of boron steel parts restoration contributes to increasing interest in new forming technologies such as shaping magnetic pulses. The evolution of mechanical properties of 22MnB5 steel during the restoration is investigated through the influence of magnetic pulses and heating of induction. It was investigated the heating of 22MnB5 blanks at temperature above 9000C. During the experiments, the forming processes at different temperatures (800, 900 and 9500C) were performed. The boron steel should be highlighted among the AHSS as the steel with the highest resistance-to-weight ratio that makes this steel is a cost-effective choice for strong and critical constructions. Boron steel's hardening and strengthening processes are strongly associated with heat treatment and bake hardening, which allows an almost complete martensite structure to be achieved with the highest resistance properties. Parts made from boron steels as well as other forms of advanced high-strength steels have some drawbacks during production and restoration operations, as the application of colossal strength is necessary to form parts made from this steel or to repair these parts after deformation. (A P Falaleev, 2016)